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Opuscula Philolichenum

small works in the field of lichenology

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The central goal of the journal is to provide timely publication, in a professional format, free of charge to authors and readers. While the journal focuses on topics relating to the lichen biota of North America this is by no means exclusive and manuscripts on other topics will be considered as the table of contents of the present issue clearly illustrates.

Authors wishing to submit a manuscript for publication in *Opuscula Philolichenum* should contact the editor prior to submission to confirm that the paper conforms to the mission of the journal (outlined above). Manuscript submissions should be left unformatted and authors should consult a recent issue of *Opuscula Philolichenum* for style. All submissions are subjected to review by at least two peer reviewers and, following acceptance are formatted by the editor.

As has been noted in the preface to previous issues the backbone of any scientific journal is its cohort of reviewers. As such the editor would like to take this opportunity to thank those who graciously provided peer review of manuscripts published in this volume: Robert Egan, Jack Elix, Theodore Esslinger, Howard Fox, Alan Fryday, Curtis Hansen, Richard Harris, James Hinds, Klaus Kalb, Martin Kukwa, Robert Lücking, Bruce McCune, Jolanta Miadlikowska, Caleb Morse, Walter Obermeyer, Frederick Seavey, Harrie Sipman, Laurens Sparrius, Goran Thor, Mats Wedin, Martin Westberg, and Timothy Wheeler. The editor also extends his sincerest thanks to the associate editors whose efforts in editing and proofing manuscripts, soliciting manuscripts, and corresponding with authors have greatly improved the quality of the journal. Thanks also to Brendan Hodkinson and Melissa Tulig for their help with the online presence of this journal.

Table of Contents

Front Matter	i-vi.
Lendemer, J.C. and R.C. Harris <i>Ramboldia blochiana</i> , a new soorediate species in the <i>Ramboldia russula</i> group.	1-4.
van den Boom, P.P.G., D. Ertz, A.M. Brand and E. Sérusiaux <i>Syncesia mascarena</i> (Roccellaceae) a new species from La Réunion (Indian Ocean).	5-10.
Lendemer, J.C. A review of the morphologically similar species <i>Fuscidea pusilla</i> and <i>Ropalospora viridis</i> in eastern North America.	11-20
Benatti, M.N. A simple clearing technique to aid in the recognition of cilia and rhizinae structure in the Parmeliaceae.	21-25.
Knudsen, K. A new member of the genus <i>Silobia</i> (Acarosporaceae) from North America.	27-30.
Knudsen, K. and H.M. Fox <i>Acarospora benedarensis</i> : a rare terricolous maritime lichen from Ireland, Scotland, and Wales.	31-34.
Hodkinson, B.P. and J.C. Lendemer <i>Punctelia eganii</i> , a new species in the <i>P. rudecta</i> group with a novel secondary compound for the genus.	35-38.
Seavey, F.C. and J.L. Seavey <i>Calopadia schomerae</i> (Pilocarpaceae), a lichen from Everglades National Park.	39-43.
Knudsen, K., J.C. Lendemer and R.C. Harris Studies in lichens and lichenicolous fungi – no. 15: miscellaneous notes on species from eastern North America.	45-75.
Knudsen, K. A preliminary study of <i>Pleopsidium stenosporum</i> (Stizenb. ex Hasse) K. Knudsen.	77-83.
Lendemer, J.C. A range extension for <i>Heiomasia seaveyorum</i> north of tropical southern Florida.	85-87.
Fryday, A.M. How should we deal with the Antarctic and Subantarctic taxa published by Carroll William Dodge?	89-98.
Lendemer, J.C. and H. O'Brien How do you reconcile molecular and non-molecular datasets? A case study where new molecular data prompts a revision of <i>Peltigera hydrothyria</i> s.l. in North America and the recognition of two species.	99-110.
Lendemer, J.C. Lichens of Eastern North America Exsiccati, Fascicle IX, nos. 401-445.	111-119.
Index to New Taxa	121.

Ramboldia blochiana, a new soorediate species in the *Ramboldia russula* group

JAMES C. LENDEMER¹ & RICHARD C. HARRIS²

ABSTRACT. – *Ramboldia blochiana*, a soorediate species in the *R. russula* group, is described as new to science based on collections from North America (U.S.A.), Central America (Mexico), South America (Brazil, Venezuela), and the West Indies (Dominican Republic, Haiti).

INTRODUCTION

The genus *Ramboldia* Kantvilas & Elix was originally described to accommodate members of the *R. stuartii*-group (Kantvilas & Elix 1994) which had previously been placed in the genus *Pyrrhospora* Körber but differed significantly from the type species of that genus, *P. quernei* (Dicks.) Körb. Subsequent study with morphological and molecular methods resulted in an expansion of the circumscription of *Ramboldia* to include members of the *P. russula*-group (Kalb et al. 2008) which had similarly been placed in *Pyrrhospora* despite their dissimilarity to *P. quernei*. *Ramboldia russula* (Ach.) Kalb et al., a common species that is widely distributed in tropical regions of the world, is likely familiar to many readers because of its distinctive bright red apothecia and white thallus with lichexanthone and fumarprotocetraric acid (Kalb et al. 2008).

During a recent foray in the Coastal Plain of southeastern North America we collected material of an unusual soorediate crustose lichen that produced lichexanthone and fumarprotocetraric acid. Further study led us to suspect that the material represented a species of *Ramboldia*, however, no such species is presently known from the genus (Kantvilas & Elix 1994, 2007; Kalb et al. 2008) and we were hesitant to describe a new species based on a collection lacking apothecia. Examination of the undetermined material in the herbarium of The New York Botanical Garden resulted in the discovery of additional collections of the same taxon from mainland South America and the West Indies, several of which were abundantly fertile. We describe this material here as *R. blochiana*.

MATERIALS AND METHODS

Specimens were studied dry using dissecting microscopes and subjected to chemical analysis using both standard spot tests (reagents are abbreviated following Brodo et al. (2001)) and Thin Layer Chromatography (TLC). TLC was carried out using solvent systems A, C, and G following the standardized methods of Culberson and Kristinsson (1970). Microscopic characters were measured in water and images were captured using an Olympus DP20 digital camera with Microsuite Special Edition. Illustrations were prepared using Adobe Photoshop. Mounts were prepared by hand with a razor blade and placed in water. All specimens cited in the taxonomic section have been seen by us unless otherwise indicated.

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THE NEW SPECIES

1. *Ramboldia blochiana* Lendemer & R.C. Harris sp. nov.

Mycobank #519896.

Plate 1 (Page 3).

Ut in *R. russula* quoad apothecia et substantias lichenum sed thallo sorediis e soraliis pustulosis formatis differt.

TYPE: **BRAZIL. BAHIA.** MUN. RIO DE CONTAS: Chapada Diamantina, lower slopes of Pico das Almas, ca. 15 km NW of Rio de Contas on road to Burmadinho, 1510 m., mostly moist forest, also rock outcrops, open areas with *Vellozia*, and campo rupestre, on *Vellozia*, 27.x.1994, *R.C. Harris 35299* (NY, holotype; SP [n.v.], hb. Kalb, isotypes).

DESCRIPTION. – Thallus corticolous, superficial, creamy white to dark gray, thin and continuous to thicker and irregularly areolate (≤ 100 μm thick), sorediate; cortex thin and poorly developed, 10-20 μm thick; prothallus not apparent; soredia arising from +/- pustular soralia, coarse, granular, not pigmented, 20-40-(50) μm in diameter, densely interspersed with granules that do not dissolve in K. Apothecia biatorine, bright red, shiny, variably aggregated, adnate; initially round but soon becoming irregular in shape; disc plane, not convex, epruinose; margin thin, flexuous, quickly excluded as the disc expands and the apothecia mature. Exciple 90-130 μm wide, bi-layered; outer layer 50-70 μm thick, prosoplectenchymatous, with the outermost cells densely interspersed with orange-red K+ red/magenta pigment; inner layer +/- prosoplectenchymatous, 60-90 μm thick, densely interspersed with coarse yellow granules that dissolve in K producing a strong yellow effusion. Hypothecium hyaline, 30-50 μm high. Hymenium hyaline, 40-60 μm high, densely interspersed with small granules that dissolve in K. Epihymenium ~10 μm high, densely interspersed with orange-red K+ red/magenta pigment. Asci 8-spored, *Lecanora*-type. Ascospores hyaline, narrowly ellipsoid, non-halonate, 10-12 x 3-4 μm . Pycnidia and conidia not seen. Photobiont green, coccoid, 7-12 μm in diameter.

ETYMOLOGY. – The epithet honors Ellen D. Bloch (b.1949), the collections manager of the Cryptogamic Herbarium at The New York Botanical Garden to whom we both owe a considerable debt for dealing with the complexities of processing incoming and outgoing specimens.

CHEMISTRY. – Lichexanthone, fumarprotocetraric acid, secalononic acid (?; apothecia only), russulone (apothecia only). Spot tests: thallus K- or weakly dirty yellow, C-, KC-, P+ red, UV+ bright yellow; apothecia K+ purple.

ECOLOGY AND DISTRIBUTION. – The new species occurs on a wide diversity of corticolous substrates (*Pinus*, *Vellozia*, *Vaccinium*, wood). It is known from scattered collections from tropical and subtropical regions of the New World. We have seen material from mainland South America (Brazil, Venezuela), the West Indies (Dominican Republic, Haiti), mainland North America (U.S.A.: southeastern Coastal Plain, southern Appalachian Mountains), and Central America (Mexico). Similar disjunct distribution patterns have been recognized for other lichens (e.g., Lendemer & Lumbsch 2008; Pérez-Vargas et al. 2010). It is likely the species is more common than the available material indicates, and that it suffers from the collection bias that often impacts sterile asexually reproducing crustose lichens (Harris & Lendemer 2010; Kantvilas & Lumbsch 2010).

DISCUSSION. – The new species appears to represent the sorediate counterpart to *Ramboldia russula*, which is sympatric throughout the range of *R. blochiana* and has the same chemistry and apothecial morphology (Kalb et al. 2008). Following Kalb et al. (2008) there are only three members of the *Ramboldia russula*-group known to produce asexual propagules, *R. arandensis* (Elix) Kalb et al., *R. cinnabarina* (Sommerf.) Kalb et al., and *R. subcinnabarina* (Tønsberg) Kalb et al. *Ramboldia arandensis* is an Australian species that produces granular isidia and only fumarprotocetraric acid, thus confusion with *R. blochiana* is unlikely. The latter two species are both known from temperate/boreal North America rather than the subtropical and tropical regions where *R. blochiana* was found and thus the taxa are not sympatric. Regardless, the new species differs chemically from *R. cinnabarina* and *R. subcinnabarina* in

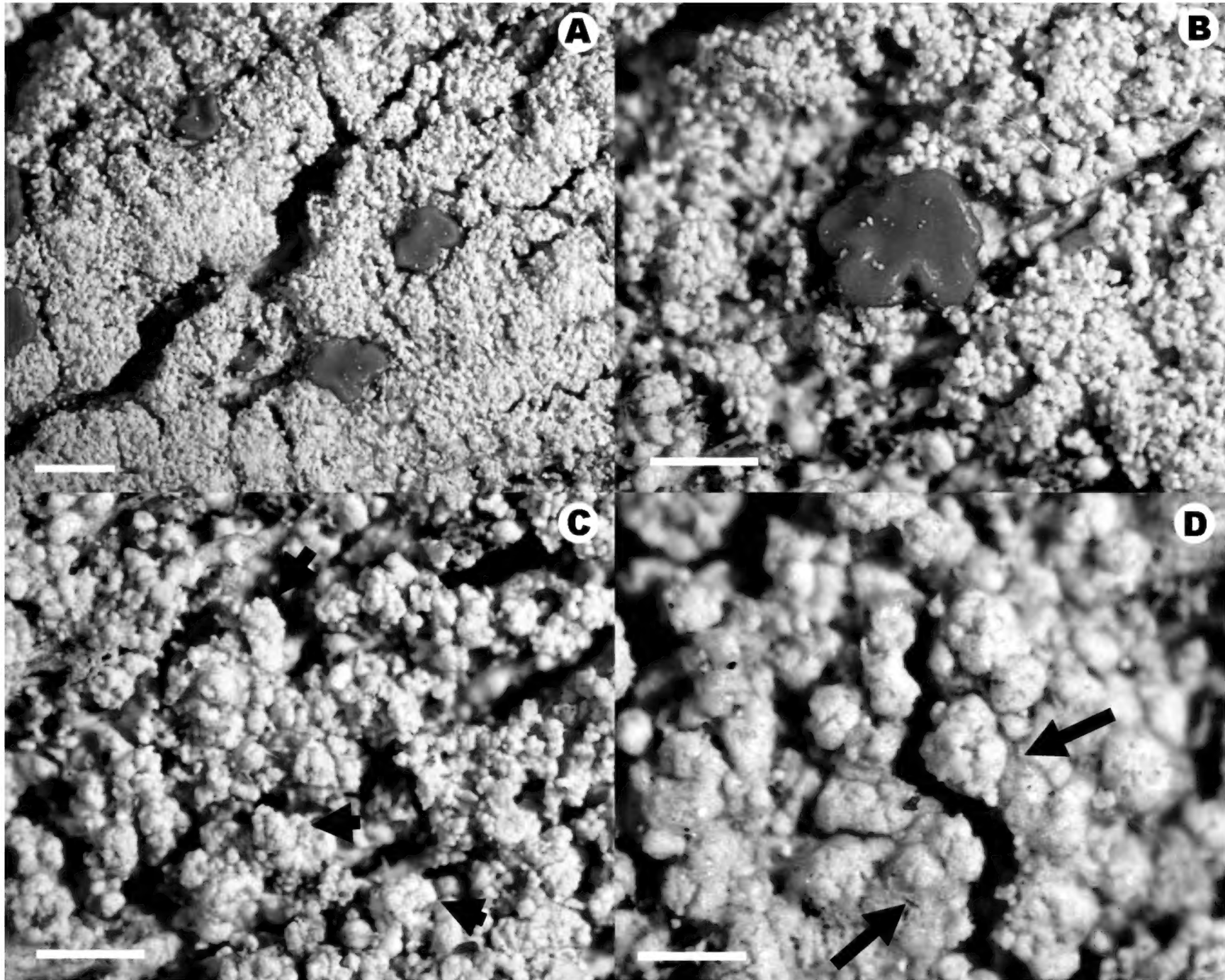


Plate 1. *Ramboldia blochiana* (all from holotype). Figure A, gross morphology of thallus (scale = 2.0 mm). Figure B, detail of apothecium (scale = 0.5 mm). Figures C-D, pustulose soralia and soredia, arrows point to developing pustules (scales = 0.5 x 0.25 mm respectively).

the production of lichexanthone and fumarprotocetraric acid (vs. atranorin and fumarprotocetraric acid in *R. cinnabarina* and fatty acids in *R. subcinnabarina*).

ADDITIONAL SPECIMENS EXAMINED. – **BRAZIL. MINAS GERAIS:** Parque Nacional do Itatiaia, along entry road near border with Rio de Janeiro in vicinity of km 4, ca. 2000 m., humid montane forest and roadbank, [on wood], 5.vii.1991, *D.M. Vital & W.R. Buck 19587* (NY, SP [n.v.], fertile); Mun. São Roque de Minas, ca. 3 km W of São Roque de Minas, dry savanna with scattered trees (cerrado), on bark, 18.ix.1984, *D.M. Vital & W.R. Buck 11902* (NY, SP[n.v.], sterile). **DOMINICAN REPUBLIC. LA VEGA PROV.:** 2.8 km from Jarabacoa on road to Jumunucu, pine forest, on *Pinus*, 12.v.1982, *R.C. Harris 15895* (NY, sterile). **HAITI. DEPT. DE L'OUEST:** Massif de la Selle, 3 km S of Kenscoff on road to Sequin, 1650 m., dry secondary growth pine slope, on *Pinus*, 17.xi.1982, *W.R. Buck 9263* (NY, fertile). **MEXICO. CHIAPAS:** Mpio. San Cristóbal de Las Casas, Fracc. La Cañada, al Periférico Sur de la ciudad de San Cristóbal. Alt. 2350 m., bosque de *Pinus* y *Quercus*, epífita, 25.vi.1994, *J. Wolf & H. Sipman 2032* (B-60-0115271, CIES [both n.v.]). **U.S.A. NORTH CAROLINA. JACKSON CO.:** Cedar Cliff Mountain, ca. 3.5 mi E of Tuckasegee, 720-1025 m., mesic forest over basic schist and gneiss with pine and juniper on dome, on wood, 11.viii.1994, *R.C. Harris 33043* (NY, sterile). **MACON CO.:** Nantahala National Forest, McDowell Mountain, ca. 10 mi S of Franklin, 640-945 m., cedar woodlands and oak-hickory woods, on *Pinus*, 12.viii.1994, *R.C. Harris 33212* (NY, sterile). **SOUTH CAROLINA. AIKEN CO.:** The Hitchcock Woods, just SW of city of Aiken, along Tea Cottage Path from entrance on Dibble Road to Chalk Cliffs, ca. 115 m., mixed pine-oak-*Kalmia latifolia* mesic sandhill woodland, on *Vaccinium*, 14.iii.2010, *R.C. Harris 56040* (NY, sterile). **VENEZUELA. AMAZONAS:** “Laja de los Lombrices”, ~2 km NW of San Juan de Ucata, ca. 120 m., granitic outcrop, on *Vellozia* root, 23.vi.1998, *P.E. Berry et al. 5289* (NY, fertile)

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LITERATURE CITED

- Brodo, I.M., S. D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven & London. 795 pp.
- Culberson, C.F. and H. Kristinsson. 1970. A standardized method for the identification of lichen products. *Journal of Chromatography*, 46: 85–93.
- Harris, R.C. and J.C. Lendemer. 2010. A review of *Lecania croatica* (syn. *Catillaria croatica*) in North America. *Opuscula Philolichenum*, 8: 41-49.
- Kalb, K., B. Staiger, J.A. Elix, U. Lange and H.T. Lumbsch. 2008. A new circumscription of the genus *Ramboldia* (Lecanoraceae, Ascomycota) based on morphological and molecular evidence. *Nova Hedwigia*, 86(1-2): 23-42.
- Kantvilas, G. and J.A. Elix. 1994. *Ramboldia*, a new genus in the lichen family Lecanoraceae. *The Bryologist*, 97: 296-304.
- Kantvilas, G. and J.A. Elix. 2007. The genus *Ramboldia* (Lecanoraceae): a new species, key and notes. *Lichenologist*, 39: 135-141.
- Kantvilas, G. and H.T. Lumbsch. 2010. A new species and a new record of Australian *Scoliciosporum*. *Australasian Lichenology*, 66: 16-23.
- Lendemer, J.C. and H.T. Lumbsch. 2008. *Protoparmelia capitata* sp. nov., and *P. isidiata* Diederich, Aptroot & Sérus., two species of *Protoparmelia* (Lecanorales, Ascomycota) from south-eastern North America. *Lichenologist*, 40(4): 329-336.
- Pérez-Vargas, I., C. Hernández Padrón, R. Arroyo, and E. Serriñá. 2010. *Usnea brasiliensis* (Zahlbr.) Motyka (Parmeliaceae), a new amphi-Atlantic disjunct lichen species. *The Bryologist*, 113(2): 308-312.

Syncesia mascarena (Roccellaceae) a new species from La Réunion (Indian Ocean)

PIETER P.G. VAN DEN BOOM¹, DAMIEN ERTZ², MAARTEN BRAND³ AND EMMANUËL SÉRUSIAUX⁴

ABSTRACT. – A new species of *Syncesia*, *S. mascarena*, is described from La Réunion (Mascarene Islands) in the Indian Ocean. *Syncesia glyphysoides* and *S. madagascariensis* are here recorded for the first time for La Réunion. This discovery reveals unexpected diversity within *Syncesia*, which was previously assumed to be mainly neotropical. Africa, including Madagascar and the Mascarene Islands, harbours six species.

INTRODUCTION

The genus *Syncesia* was revised by Tehler (1997) who accepted 17 species, with only two species from Africa: *S. intercedens* (Müll. Arg.) Tehler from Tanzania and South Africa, and *S. mollis* (Müll. Arg.) Tehler from Tanzania. Besides the discovery of a new species in the Caribbean Islands (Sipman 2009), research on the material recently collected in Africa yielded two new and very characteristic species: *S. afromontana* Ertz, Killmann, Sérus. & Eb. Fisch. from Rwanda and *S. madagascariensis* Ertz, Killmann, Razafin., Sérus. & Eb. Fisch. from Madagascar (Ertz et al. 2010). A further new species and two new records have come to light with the study of material collected in 2003, 2008 and 2009 on La Réunion in the Indian Ocean and those results are presented in this paper. The total number of species of *Syncesia* in Africa now thus reaches six.

The genus *Syncesia* belongs to the Roccellaceae, a large family within the Arthoniomycetes (Nelsen et al. 2009; Ertz et al. 2009) including numerous generic entities, whose circumscription is still in a state of flux (Ertz & Tehler 2011). *Syncesia* is characterized by stromatoid ascomata with exposed, pruinose and/or tomentose discs, carbonized hypothecium, fusiform mainly 3-septate ascospores and by usually producing protocetraric and roccellic acids. It has recently been demonstrated to be monophyletic in a phylogeny including eight species of the genus (Ertz & Tehler 2011).

La Réunion is a large island covering approximately 2,512 km² in the Indian Ocean, east of Madagascar, that is part of the Mascarenes Archipelago. It is a serrated mountain range reaching 3,069 m in elevation at the Piton des Neiges, with dramatic and continuous volcanic activity at the Piton de la Fournaise and contrasting rainfalls (from 10,000-12,000 mm at Hauts de St Rose to 540 mm at St Gilles). The centre of the island is dissected in huge “cirques” and very deep gorges. Much of the pristine vegetation has been destroyed and only forests and heather formations at high elevations remain partly untouched (Cadet 1977; Strasberg et al. 2005). The fascinating pristine fauna and flora of the Mascarene Archipelago have been decimated since mankind arrived in 1598, and the dodo (*Raphus cucullatus*), a flightless bird belonging to the Columbidae and endemic to Mauritius, is the emblematic representative of this lost biome (Cheke & Hume 2008). Nevertheless, much of the biodiversity of the Mascarene Islands and their phylogeography remain to be studied: new endemic species continue to be described (e.g. new species in the Orchidaceae: Bosser 2007) and the scenario of long-distance dispersal, followed by phylogenetic divergence, is now favored over the vicariance pattern (Warren et al. 2009). The lichen flora of La Réunion is poorly known and has never been thoroughly revised (current checklist available at

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http://www.biologie.uni-hamburg.de/checklists/lichens/africa/france_reunion_1.htm). It is currently under investigation by our group.

MATERIALS AND METHODS

Material for this study was collected during some recent field trips to La Réunion (Indian Ocean) by D. Ertz in 2003, P. & B. van den Boom, D. & M. Brand and E. Sérusiaux in 2008 and N. Magain and E. Sérusiaux in 2009. Microscopical examination was carried out using hand-made sections in water (H₂O), 5% KOH (K), or Lugol's reagent (1% I₂) without (I) or with KOH pre-treatment (K/I). Measurements and drawings of asci and ascospores all refer to material examined in water. Ascospore measurements are indicated as (minimum) $\bar{x}-\sigma_x$ – $\bar{x}+\sigma_x$ (–maximum), followed by the number of measurements (n); the length/breadth ratio of the ascospores is indicated as l/b and given in the same way. For the other characters, the minimum and the maximum values are given. Thin-layer chromatography (TLC) of acetone extracts was performed in solvent systems C and G on silica gel 60 F₂₅₄ layer glass plates of 20 × 20 cm. For the visualization of the spots, 10% sulphuric acid was used as a reagent (Orange et al. 2001).

Additional specimens examined: *Syncesia intercedens* (lectotype, G) and material of *Syncesia farinacea* (Fée) Tehler from B.

THE SPECIES

1. *Syncesia mascarena* van den Boom, Ertz, M. Brand & Sérus. sp. nov.

Mycobank #519604.

PLATE 1, FIGURES A-C (PAGE 7).

Similis *Syncesiae intercedentis* sed thallo non tomentoso, aqua absorbente, areolato; areolis 0.3–0.5 mm latis, convexis, albidis ad pallide fuscis, usque ad 0.4 mm altis, ecorticatis; ascomatis disco plano, pallide fusco; ascosporis fusiformibus, saepe paulo curvatis, (36–)42–50(–55) × (4–)4.5–5.2(–5.5) µm.

TYPE. – **MASCARENE ISLANDS**. LA RÉUNION: Cirque de Cilaos, N of Cilaos, S edge of Forêt du Grand Matarum, along road to Bras Sec, big boulders and outcrops along stream, on acidic rock, 55°28.90' E 21°07.40' S, 1360 m, 31.v.2008, P. & B. van den Boom, M. & D. Brand 59608 & E. Sérusiaux (LG, holotype; BR, REU, hb. Brand, isotypes).

DESCRIPTION. – **Thallus** saxicolous (rarely on roots or base of nearby trees), extensive (>15 cm in diam.), not tomentose, water absorbent, made of 0.3–0.5 mm wide, convex, whitish to pale brownish, up to 0.4 mm thick, ecorticate areolae with a partly brownish medulla when thick. Prothallus distinct with radiating brownish hyphae or indistinct. **Ascomata** pseudomonocarpocentral, synascomata convex, adnate, tomentose to velvety, without constricted base, up to 4 mm diam. and 2 mm high; disc flat, ca. 0.3 × 0.1 mm, brownish; **thalline margin** light brownish, not raised, made of loose hyphae containing minute crystals of roccellic acid, often tomentose and velvety, with scattered algae; **hypothecium** dark brown, K+ greenish, extending down to substrate or not; **hymenium** 100 µm high; paraphysoids distinct, 1.5 µm in diam., branched; **epithecium** 35 µm high, with paraphysoids richly branched, brownish, verruculose. **Asci** 100–105 × 15–17 µm, clavate. **Ascospores** fusiform, often slightly curved, (36–)42–50(–55) × (4–)4.5–5.2(–5.5) µm, l/b ratio 8.6–10.3 (n=40), old spores light brownish, verruculose. **Pycnidia** not rare, immersed, often on top of areola, to 300 × 200 µm, top of pycnidial wall brown. **Conidia** curved (semi-circular), ca. 18.5 × 0.8 µm.

CHEMISTRY. – Spot tests: thallus K–, C–, KC–, P+ orange-red, UV–. Synascomata and surrounding thallus with roccellic acid, protocetraric acid and an unidentified pale brownish substance, Rf 52 in C and 78 in G, UV+ bluish after H₂SO₄ treatment and heating (TLC). Calcium oxalate crystals present, especially in old apothecia. Epithecium, hymenium and subhymenium dextrinoid (I and K/I+ yellow-orange); asci with hemiamyloid inner layer.

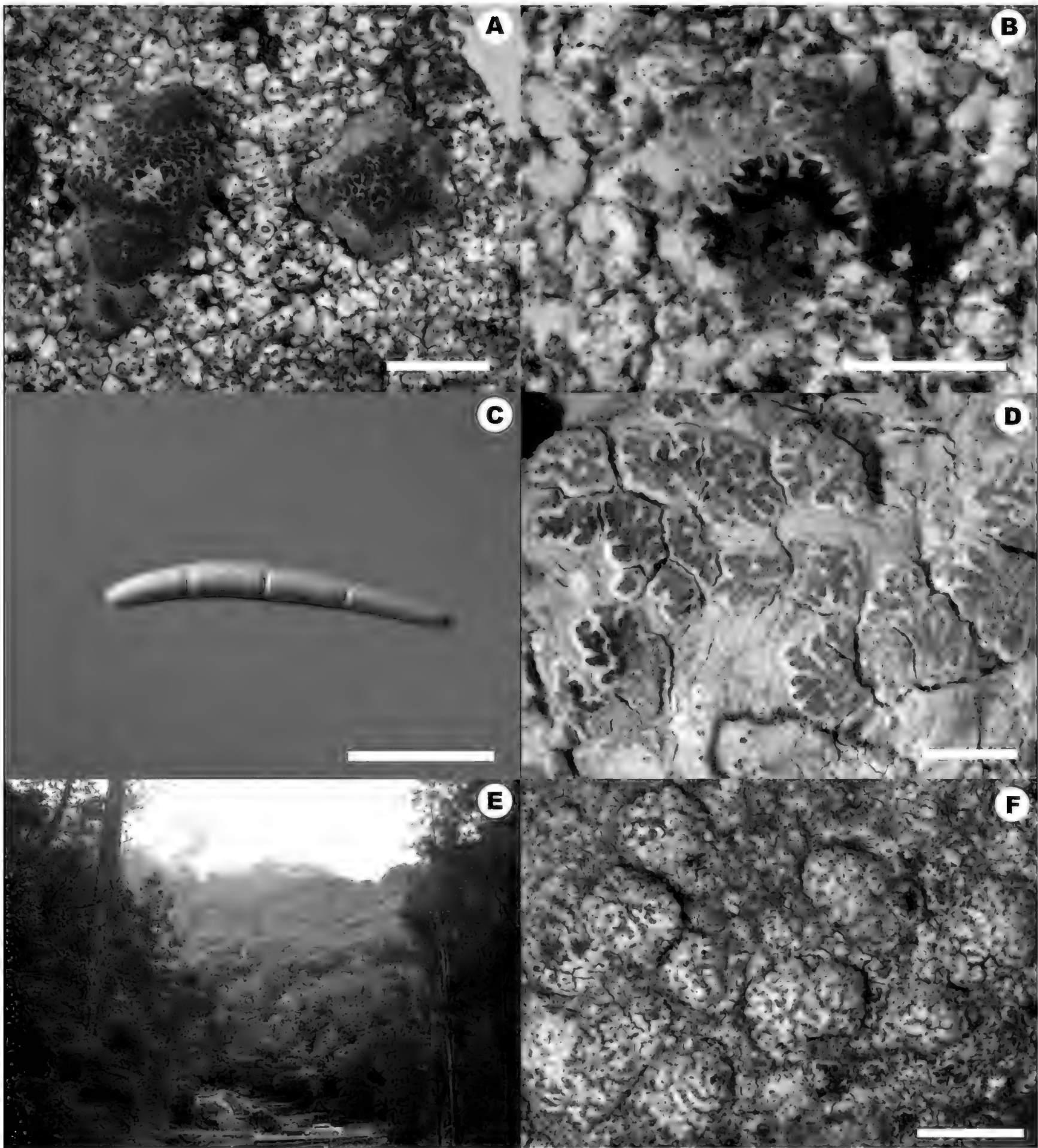


Plate 1. Figure A-C *Syncesia mascarena* (Brand 59608). A, thallus and ascomata (scale = 2 mm). B, cross section through an ascoma showing the dark brown hypothecium (scale = 1 mm). C, ascospore (scale = 20 μ m). D, thallus and ascomata of *S. glyphysoides* (Ertz 4770, scale = 1 mm). E, the type locality of *S. mascarena*. F, thallus and ascomata of *S. cf. farinacea* (Sipman 54843, scale = 2 mm).

ECOLOGY AND DISTRIBUTION. – The new species is known from two localities on La Réunion, one at low elevation and the other in the montane forest zone; in both, it is abundant on rocks in sheltered overhangs or on boulders.

DISCUSSION. – *Syncesia mascarena* is characterized by a warty thallus, brownish tomentose to velvety not constricted synascomata, a dextrinoid hymenium and epithecium, and long ascospores. *Syncesia farinacea* differs from the new species by shorter ascospores (25-31 μm according to Tehler (1997)), an amyloid epithecium and hymenium and usually corticolous habit. Sipman (2009) reported *S. cf. farinacea* from rock on Saba (West Indies) and observed longer ascospores in these saxicolous specimens (36-48 x 5 μm) that could thus represent *S. mascarena*. However, according to Sipman (pers. comm.) and following detailed examination of two specimens (*Buck 50584* and *Sipman 54843* (B), fig. 1F), the material from Saba differs in having pale (grayish brown to whitish grey) ascomata with much less divided disc, which are more star-shaped and strongly constricted at base. In *Sipman 54843* the ascomata are distinctly UV+ yellow contrasting with the UV- thallus whereas the thallus of *Buck 50584* has UV+ yellow spots. Further, no pycnidia could be found. This material deviates from *S. farinacea* (Fée) Tehler s. str. by a warty thallus, convex to semi-globose ascomata, the presence of an UV+ yellow substance, longer ascospores and saxicolous habit. We suggest a close affinity of this material with *S. glyphysoides* (Fée) Tehler despite the fact that this species is only known to be corticolous. Two other species are also found on rocks: *S. myrticola* Fée and *S. sulphurea* (Vain.) Tehler. The former differs from *S. mascarena* by the following characters: usually whitish to pale grey, non tomentose synascomata that are usually constricted at the base, and slightly shorter ascospores (35-44 μm according to Tehler (1997)). The latter differs clearly by its smaller ascospores (27-28 x 5 μm) and the absence of fatty acids. Amongst the corticolous *Syncesia*, the closest species to *S. mascarena* is the African *S. intercedens*, which differs by a thinner, tomentose, water-repellent and coherent thallus (not areolate), white or pale gray synascomata with dark grayish hymenial discs and slightly shorter ascospores (37-41 μm according to Tehler (1997), but up to 46 μm long according to our observation of the lectotype specimen).

OTHER SPECIMENS EXAMINED. – **MASCARENE ISLANDS. LA RÉUNION:** Same locality as the type, *P. van den Boom 40198* (hb v.d. Boom), *E. Sérusiaux s.n.* (LG); St-Joseph, Pont Babet, 55°39.21' E 21°20.49' S, 65 m, shaded boulders by a river, on acidic rock, 3.vi.2008, *E. Sérusiaux s.n.* (LG).

2. *Syncesia glyphysoides* (Fée) Tehler

PLATE 1, FIGURE D (PAGE 7).

DISCUSSION. – This species was previously known from the Neotropics: West Indies, S-E Brazil, and USA/Florida (Tehler 1997; Ertz et al. 2010) and from continental Africa: Angola and Gabon (Ertz & Tehler 2011). It is here reported as new for the Mascarene Islands and should therefore be more widespread than previously assumed. The species is characterized by its thallus UV+ bright yellow (substance unknown; lichexanthone according to Sipman 2009) and the long 3-septate ascospores (41-50 x 4 μm).

SPECIMENS EXAMINED. – **MASCARENE ISLANDS. LA RÉUNION:** Forêt de Bélouve, near Gîte de Bélouve, mature plantation of *Acacia heterophylla* trees in mixed forest, on *A. heterophylla*, 55°32.50' E 21° 03.50' S, 1520 m, 27.v.2008, *P. van den Boom 39860* (hb v.d. Boom), *E. Sérusiaux s.n.* (LG); ibid., 2.vi.2008, *P. van den Boom 40395* (hb. v.d. Boom). Réserve naturelle de la Roche Ecrite, le long du sentier de la Roche Ecrite, 55°26' E 20°58' S, 1500-1680 m, forêt de moyenne altitude à Tamarin des hauts (*Acacia heterophylla*), tronc éclairé d'*Acacia heterophylla*, 29.vi.2003, *D. Ertz 4770* (BR).

3. *Syncesia madagascariensis* Ertz, Killmann, Razafin., Sérus. & Eb. Fisch.

DISCUSSION. – This recently described species was only known from the type locality in Madagascar, also in a montane forest (Ertz et al. 2009). It is the only species of the genus with 5-septate ascospores. When mature, its thallus becomes densely verrucose and seems to be almost entirely made of contiguous hemispherical verrucae. New for the Mascarene Islands.

SPECIMENS EXAMINED. – **MASCARENE ISLANDS. LA RÉUNION:** Cirque de Cilaos, Forêt du Grand Matarum, trail to Caverne Dufour, montane rainforest (Bois de Couleurs des Hauts), on a trunk of an unidentified tree, 55°29.20'

E 21°07.30' S, 1420 m, 31.v.2008, *P. van den Boom* 40280 (hb v.d. Boom). Ibid., on a trunk of an unidentified tree, 1540 m, 12.xi.2009, *N. Magain & E. Sérusiaux s.n.* (LG).

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LITERATURE CITED

- Bosser, J. 2007. Contribution to the study of the Orchidaceae from Madagascar, the Comoro islands and the Mascarenes. XXXVI. Descriptions of a new *Cynorkis* from Reunion and a new *Angraecum* from Madagascar. *Adansonia*, 29: 13-17.
- Cadet, T. 1977. La végétation de l'Ile de La Réunion: étude phytoécologique et phytosociologique. Thèse, Université de Marseille, 312 pp.
- Cheke, A. and J. Hume. 2008. Lost land of the dodo. An ecological history of Mauritius, Réunion & Rodrigues. T & AD Poyser, London. 540 pp.
- Ertz, D. and A. Tehler. 2011. The phylogeny of Arthoniales (Pezizomycotina) inferred from nucLSU and RPB2 sequences. *Fungal Diversity*, 46 (in press).
- Ertz, D., D. Killmann, T. Razafindrahaja, E. Sérusiaux and E. Fischer. 2010. Two new species of *Syncesia* (Arthoniales, Roccellaceae) from Africa. *Lichenologist*, 42: 43-49.
- Ertz, D., J. Miadlikowska, F. Lutzoni, S. Dessein, O. Raspé, N. Vigneron, V. Hofstetter and P. Diederich. 2009. Towards a new classification of the Arthoniales (Ascomycota) based on a three-gene phylogeny focussing on the genus *Opegrapha*. *Mycological Research*, 113: 141-152.
- Nelsen, M.P., R. Lücking, M. Grube, J.S. Mbatchou, L. Muggia, E. Rivas Platas and H.T. Lumbsch. 2009. Unravelling the phylogenetic relationships of lichenised fungi in Dothideomyceta. *Studies in Mycology*, 64: 135-144.
- Orange, A., P. W. James and F. J. White. 2001. Microchemical methods for the identification of lichens. British Lichen Society. 101 pp.
- Sipman, H. 2009. The lichen genus *Syncesia* (Arthoniales) on Saba and St. Eustatius (West Indies). *Opuscula Philolichenum*, 7: 55-60.
- Strasberg, D., M. Rouget, D. Richardson, S. Baret, J. Dupont and R.M. Cowling. 2005. An assessment of habitat diversity and transformation on La Réunion island (Mascarenes Islands, Indian Ocean) as a basis for identifying broad-scale conservation priorities. *Biodiversity and Conservation*, 14: 3015-3032.
- Tehler, A. 1997. *Syncesia* (Arthoniales, Euascomycetidae). *Flora Neotropica*, 74, New York Botanical Garden (for Organization for Flora Neotropica), New York. 48 pp.
- Warren, B.H., D. Strasberg, J.H. Bruggemann, R.P. Prys-Jones and C. Thébaud. 2009. Why does the biota of the Madagascar region have such a strong Asiatic flavour? *Cladistics*, 26 (5): 453-562.

A review of the morphologically similar species *Fuscidea pusilla* and *Ropalospora viridis* in eastern North America

JAMES C. LENDEMER¹

ABSTRACT. – The distinguishing features of *Ropalospora viridis* and *Fuscidea pusilla* are discussed. The geographic distributions of the two species in eastern North America are revised: although both species have an Appalachian-Great Lakes distribution they have somewhat differing biogeographic tendencies. *Fuscidea pusilla* is a rare species of the northern boreal forests with disjunct populations in the central Appalachian Mountains, whereas *R. viridis* is common and widespread throughout the Appalachian Mountains and their outliers with disjunct populations in the Great Lakes. Color illustrations of both species are provided.

INTRODUCTION

In conjunction with fieldwork for my dissertation studies on the genus *Lepraria* s.l., I have collected sterile crustose lichens throughout North America. During my field studies in temperate eastern North America I have frequently encountered small brownish or greenish circular sorediate thalli on the bark of various trees and even occasionally on rocks. Discussion with colleagues and collectors elsewhere in the region revealed that others were also perplexed by such material because it does not react with most standard spot tests (K, C, P). Often these thalli fluoresce blue-white under UV light and Thin Layer Chromatography consistently revealed the presence of a single substance resembling perlatolic or divaricatic acid.

Using the seminal work on sterile crustose lichens (Tønsberg 1992) these collections keyed to either *Fuscidea pusilla* or *Ropalospora viridis*, both of which have been reported from North America (Tønsberg 1993, 1993a). Although these two species differ chemically and morphologically (Tønsberg 1992) I have never been confident in my ability to distinguish between them, primarily because of a lack of precise chemical analyses and adequate published illustrations. After a recent collecting trip to coastal Maine I decided to again attempt to elucidate the differences between these taxa. Using solvent systems A and B' coupled with standards for divaricatic and perlatolic acid derived from crustose lichens, I was able to resolve the chemistry for all of the collections at NY (more than 200 collections). This study revealed that a number of collections, including several used for published reports, had been misidentified. It also became clear that the morphological differences outlined by Tønsberg (1992) to separate *F. pusilla* and *R. viridis* were not clear cut, and that a significant complicating factor was a lack of high quality color images. Considering the above it seemed as though a fully illustrated publication detailing the distributions of these two species in eastern North America would be helpful to those attempting to identify sterile crustose lichens.

MATERIALS AND METHODS

This study is based primarily on material collected by the author and his collaborators. All of this material has been deposited in herbarium of The New York Botanical Garden (NY). In order to obtain additional distributional data selected specimens from CANL and MIN were also borrowed and studied. In total more than 200 specimens were examined.

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	Sol. A	Sol. B	Sol. B'	Sol. C
Confluent acid	48	32	32	46
Divaricatic acid	39	75	68	51
Perlatolic acid	44	77	75	54

Table 1. Rf values of relevant substances reproduced from Mietzsch et al. 1992.

Specimens were studied dry using a dissecting microscope and subjected to chemical analysis using both standard spot tests (reagents are abbreviated following Brodo et al. (2001)) and Thin Layer Chromatography (TLC). TLC was carried out using solvent systems A and B following the standardized methods of Culberson and Kristinsson (1970), except modified such that it was carried out in large glass peanut butter or mayonnaise jars using aluminum plates that had been cut to fit 10 to 14 lanes at a time.

Each sheet included standards for divaricatic and perlatolic acids. The standards for perlatolic acid were derived from specimens of *Ropalospora chlorantha* (Tuck.) S. Ekman at NY while those for divaricatic acid were derived from specimens of *Fuscidea arcuatula* (Arn.) Hertel et al. at NY. Initially, additional standards for divaricatic and perlatolic acids, derived from *Evernia mesomorpha* Nyl. and *Cladonia stellaris* (Opiz) Pouzar & Vezda, respectively, were also included for comparison. These were excluded after it became clear that the substances in these macrolichens were present in considerably higher concentrations than in the samples taken from crustose species. The higher concentrations of these substances made it easy to overload spots, causing streaking, thus rendering difficult the comparison between compounds with close Rf values (see table 1 above for comparative Rf values of divaricatic and perlatolic acids.)

RESULTS AND DISCUSSION

Sterile asexually reproducing crustose lichens comprise a significant component of the lichen biota of North America that has been neglected and understudied (Harris & Lendemer 2010). Although our knowledge of this group in North America has increased considerably in recent years, the constantly high number of species that continue to be described and reported serves to illustrate just how much work remains to be done. As a whole, these taxa are heavily impacted by collector bias because they are perceived as taxonomically difficult (Kantvilas & Lumbsch 2010) and as such their biological diversity has been underestimated and their biogeographic relationships obscured. Indeed, recent unpublished studies by the author indicate that even the most common and widespread species are poorly represented in most herbaria.

It is only through increased intensive collection efforts throughout the continent that this impediment will be overcome. The present study clearly illustrates that this is the case. Despite an inability to identify *Fuscidea pusilla* and *Ropalospora viridis* with confidence, the author and his colleagues continued to actively collect and accumulate collections of the species, assuming that these would aid in elucidating ecological preferences and biogeographic patterns. Eventually it became possible to distinguish between these species with confidence using Thin Layer Chromatography to determine which diagnostic compound was present in a given specimen. Careful examination of the large amount of available material (table 2) led to the recognition that a set of correlated secondary morphological, ecological, and biogeographic character states (table 3) could be used to predict chemistry, and thus taxonomic identity, a high percentage of the time. Thus, although chemical analysis is required to confirm the identification of a given specimen, the use of alternative correlated secondary characters can also typically be used to arrive at the correct identification. This is particularly valuable because it renders two previously confused species identifiable to non-specialists and those without access to sophisticated or expensive laboratory equipment. An illustrated account of *Fuscidea pusilla* and *Ropalospora viridis* is provided below.

		<i>pusilla</i>			<i>viridis</i>			
		number			number			
		# of specimens			19			210
# of collections		19			194			
Substrate			% of collections	% by substrate		% of collections	% by substrate	
	<i>Acer</i>	0	0%	0%	62	37%	36%	
	<i>Betula</i>	7	37%	70%	35	20%	20%	
	<i>Quercus</i>	0	0%	0%	14	7%	8%	
	<i>Populus</i>	0	0%	0%	9	5%	5%	
	shrubs	3	16%	30%	11	6%	6%	
	<i>Carya</i>	0	0%	0%	4	2%	2%	
	<i>Fraxinus</i>	0	0%	0%	5	3%	3%	
	<i>Fagus</i>	0	0%	0%	2	1%	1%	
	<i>Prunus</i>	0	0%	0%	1	1%	1%	
	<i>Salix</i>	0	0%	0%	1	1%	1%	
	indet hardwood	0	0%	0%	13	7%	8%	
	all hardwoods	10	53%		157	81%		
			% of collections	% by substrate		% of collections	% by substrate	
	<i>Pinus</i>	2	11%	22%	6	3%	18%	
	<i>Abies</i>	1	5%	11%	11	6%	33%	
	<i>Tsuga</i>	0	0%	0%	5	3%	15%	
	<i>Thuja</i>	0	0%	0%	4	2%	12%	
	<i>Picea</i>	6	32%	67%	6	3%	18%	
	indet conifer	0	0%	0%	1	1%	3%	
	all conifers	9	47%		33	17%		
				% of collections	% by substrate		% of collections	% by substrate
	rock	0	0%	0%	4	2%	N/A	

Table 2. Tabular comparison of specimen/substrate statistics for the two species.

	<i>pusilla</i>	<i>viridis</i>
chemistry	divaricatic	perlatolic
distribution in e North America	boreal/northern with disjunct populations in "northern" habitats in the central Appalachians	Appalachian-Great Lakes
thallus color	typically light green	typically dark green or brownish
prothallus	typically dark	variable, dark to light
typical substrate	<i>Betula</i> and conifers	hardwoods
relative frequency	(19/213) = 9%	(194/213) = 91%

Table 3. Tabular comparison of primary and secondary characters distinguishing *Fuscidea pusilla* and *Ropalospora viridis*.

TREATMENT OF THE SPECIES

1. *Fuscidea pusilla* Tønsberg, Sommerfeltia, 14: 138. 1992. TYPE: NORWAY. HEDMARK: mot, set-Bechsminne, along state road 3, 240 m., 6.vii.1983, on *Betula pubescens/pendula*, T. Tønsberg 8041 (BG, holotype; E, UPS, isotypes [all n.v.]).

PLATE 1 & 2C-F (PAGES 15 & 16).

DESCRIPTION. – The description published by Tønsberg (1992) characterizes well the specimens examined in this study.

CHEMISTRY. – Divaricatic acid. Spot tests: K-, C-, KC- or weakly + fleeting reddish-pink, P-, soralia UV+ blue-white.

ECOLOGY AND DISTRIBUTION. – Tønsberg (1993a) first reported *Fuscidea pusilla* from North America on the basis of a collection on *Abies balsamea* in the Adirondack Mountains of New York. The geographic distribution of the species in North America was recently summarized by Fryday (2008) who included several records from the Appalachian Mountains that were based on misidentified specimens. The distribution map provided here (plate 4) reflects this change. The results of the present study indicate that *F. pusilla* is uncommon but locally abundant in the humid boreal forests of New England, the Canadian Maritimes, and the Pacific Northwest.

The small number of specimens examined renders it difficult to draw conclusions about the ecology of *Fuscidea pusilla*. The specimens were more or less equally divided between *Betula* (10 of 19) and conifers (9 of 19), particularly northern boreal taxa such as *Picea* (5 of 9). The species was not found on any hardwood tree except *Betula*.

DISCUSSION. – When Tønsberg (1992) described *Fuscidea pusilla* he emphasized the utility of several thallus characters (i.e., small size, light greenish color, and a dark brown prothallus) in distinguishing the new taxon from *Ropalospora viridis*. Based on the material examined these differences are accurate, and once one is familiar with the two taxa it is possible to separate them morphologically a high percentage of the time. Unfortunately the high degree of morphological variability displayed by *R. viridis* makes confirmation with TLC a requirement. Recently Gilbert et al. (2009) have suggested that *F. pusilla* likely represents a juvenile morphotype of *F. lightfootii* (Sm.) Coppins & P. James. As noted by those authors, further study with molecular data is needed to determine whether this is the case. As presently circumscribed, *F. lightfootii* differs from *F. pusilla* in having a thallus that resembles *F. arboricola* Coppins.

The only other typically corticolous sorediate crustose lichen reported from North America that is likely to be confused with *Fuscidea pusilla* is *Lecidea nylanderi* (Anzi) Th. Fr. Both species produce divaricatic acid but *L. nylanderi* occurs primarily on conifers and has an inconspicuous immersed primary thallus from which minute gray or gray-brown areoles arise and immediately dissolve into soredia, giving the appearance of a leprose crust. In contrast, the thallus of *F. pusilla* is typically larger, distinctly green in color, and comprised primarily of distinct persistent areoles with more or less discrete soralia. The two species also have different photobionts (*Chlorella*-type in *Fuscidea* and *Trebouxia*-type in *L. nylanderi*; Fryday (2008)). Although in his key Tønsberg (1992) used substrate (conifers in *L. nylanderi* vs. hardwoods in *F. pusilla*) as a character to distinguish between these taxa, 47% of the specimens of *F. pusilla* reviewed in this study occurred on conifers.

Fuscidea recensa (Stirton) Hertel, V. Wirth & Vězda is another sorediate crustose lichen that could be confused with *F. pusilla* because it produces divaricatic acid. Although it is typically saxicolous, occasional corticolous populations have been found in Europe. Such populations would be difficult to separate from *F. pusilla* in the absence of apothecia (Fryday 2008). While the thallus of *F. recensa* is usually white or gray in color (vs. green in *F. pusilla*) this character is very variable. A single corticolous collection of *F. recensa* was reported from North America by Fryday (2008). However, that specimen was identified as *F. pusilla* in the present study.

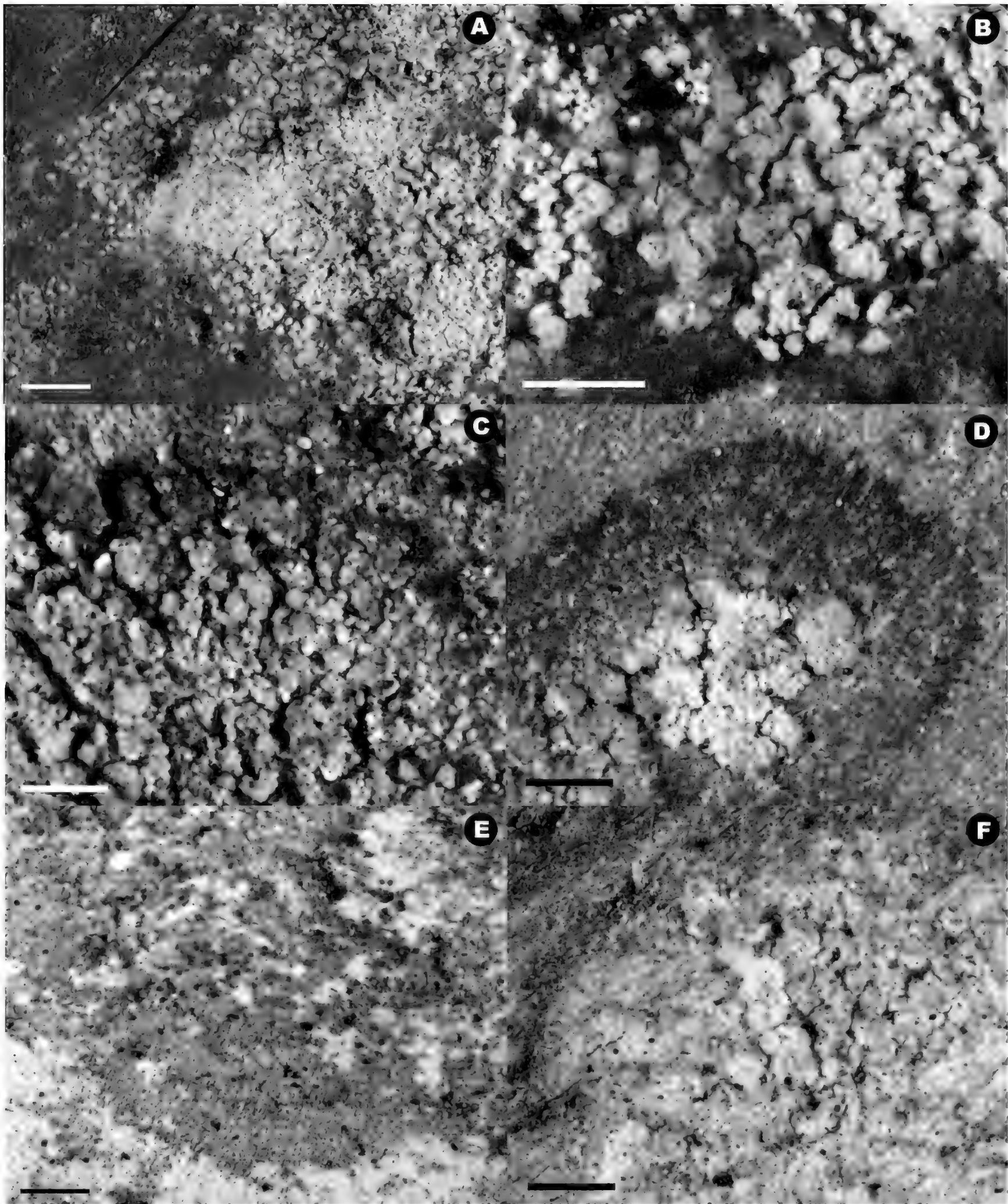


Plate 1. Thallus variation in *Fuscidea pusilla*. A-B, form with indistinct/immersed prothallus and well developed pale thallus (*Lendemer 27317*, scales = 1.0 & 0.5 mm respectively). C, form with narrow prothallus and well developed brownish thallus (*Harris 54610*, scale = 0.5 mm). D, form with extensive developed dark prothallus (*Buck 47134*, scale = 0.5 mm). E, form with distinctly fibrous prothallus and thin thallus (*Lendemer 22552*, scale = 0.5 mm). F, form with pale prothallus and thin thallus (*Buck 47134*, scale = 0.5 mm).

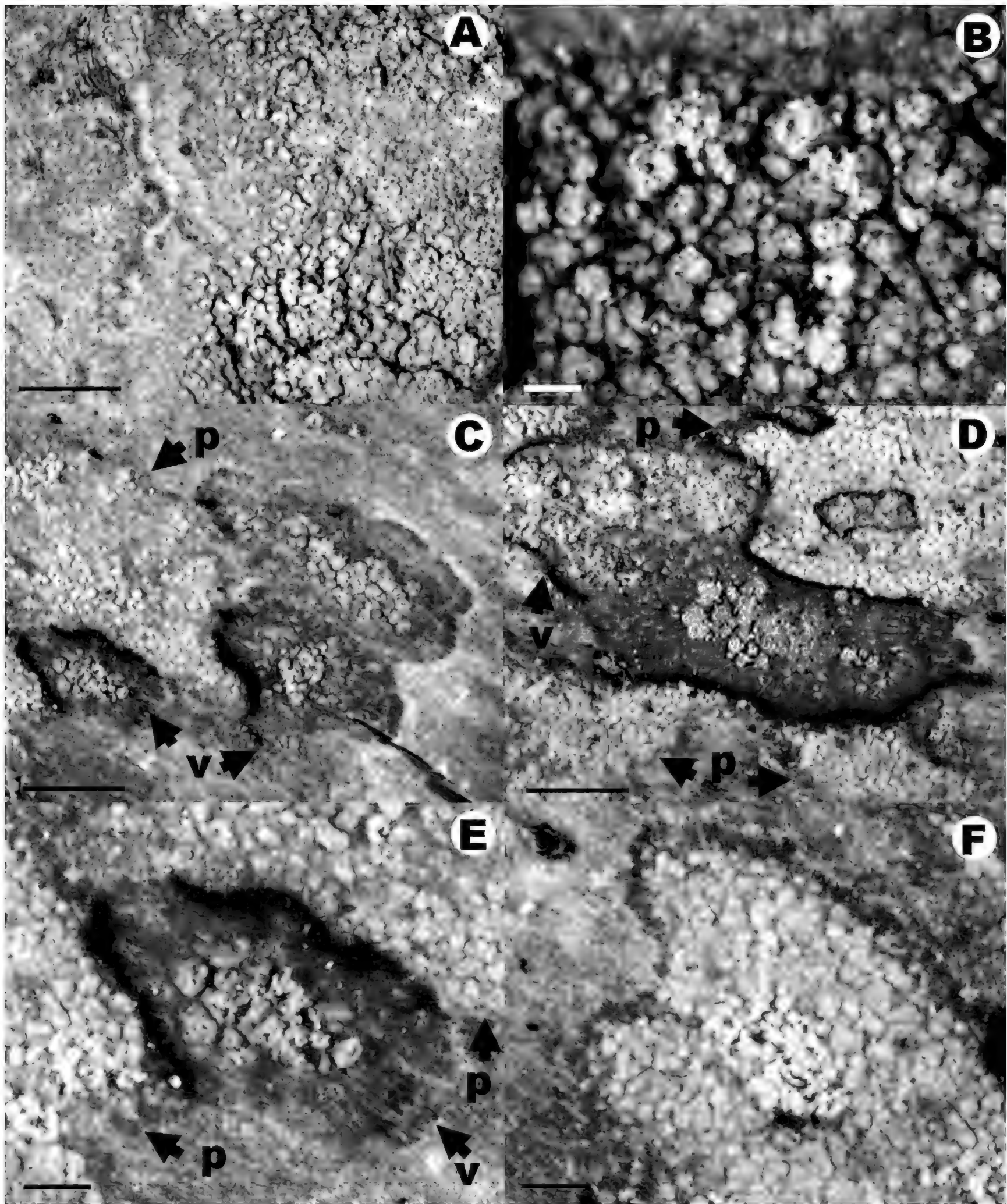


Plate 2. Comparison of *Fuscidea pusilla* and *Ropalospora viridis*. A-B, typical thallus and soralia of *Ropalospora viridis* (A= *Lendemer 13961*, scale = 1.0 mm; B= *Lendemer 1609*, scale = 0.2 mm). C-E, both species growing side-by-side (p= *pusilla*, v= *viridis*; *Harris 54897*, scales = 1.0, 1.0, and 0.25 mm respectively). F, typical thallus of *Fuscidea pusilla* (*Harris 54897*, scale = 0.25 mm).

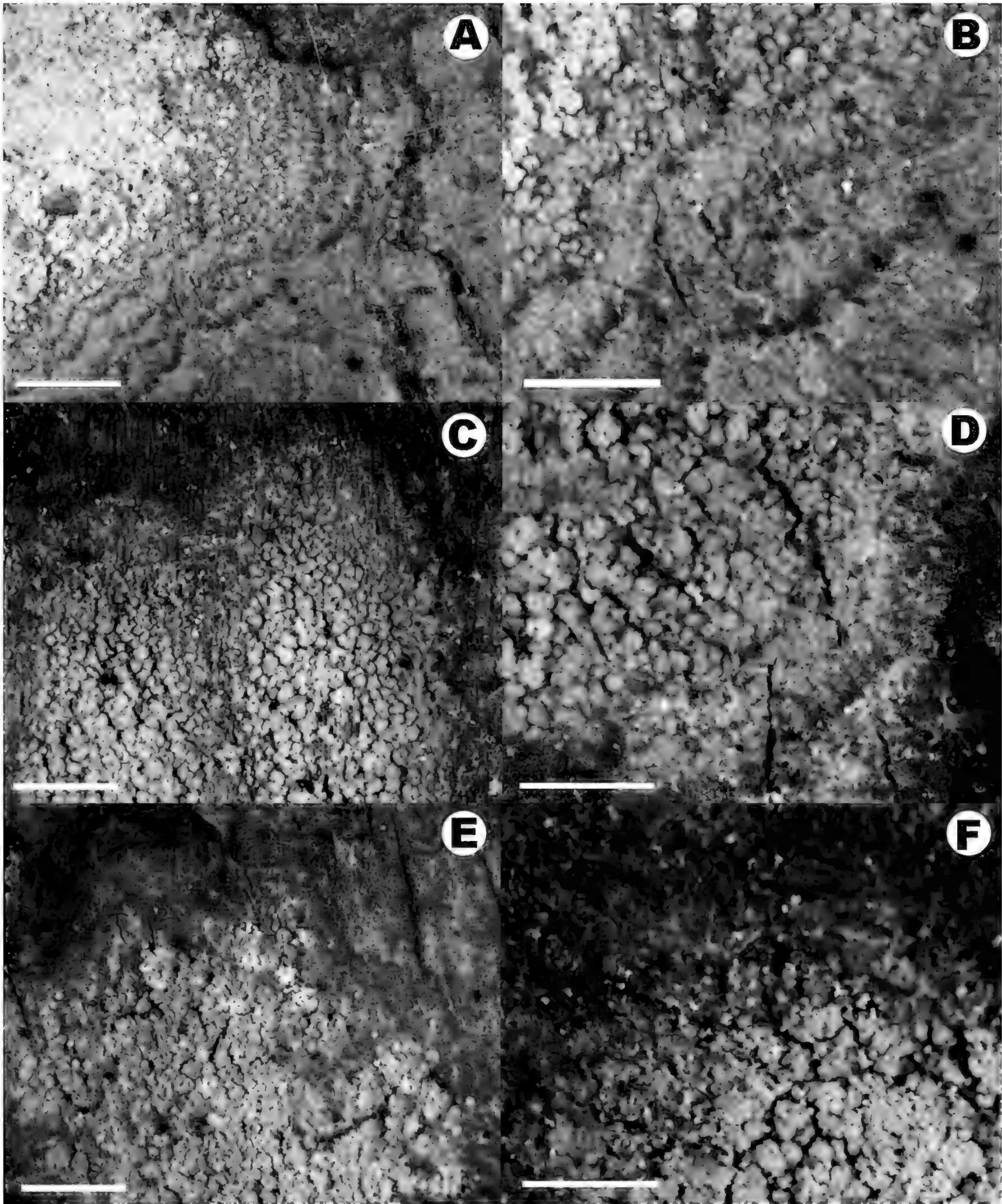


Plate 3. Variation in *Ropalospora viridis*. A-B, form with fine soredia and well developed zoned prothallus (*Lendemer 2203*, scales = 1.0 & 0.5 mm respectively). C, form with coarse soredia and pale unzoned prothallus (*Lendemer 1285*, scale = 1.0 mm). D, form with coarse soredia and zoned prothallus (*Lendemer 1609*, scale = 0.5 mm). E, form with indistinct brownish prothallus (*Lendemer 1804*, scale = 1.0 mm). F, form with immersed pale prothallus (*Lendemer 1285*, scale = 0.5 mm).

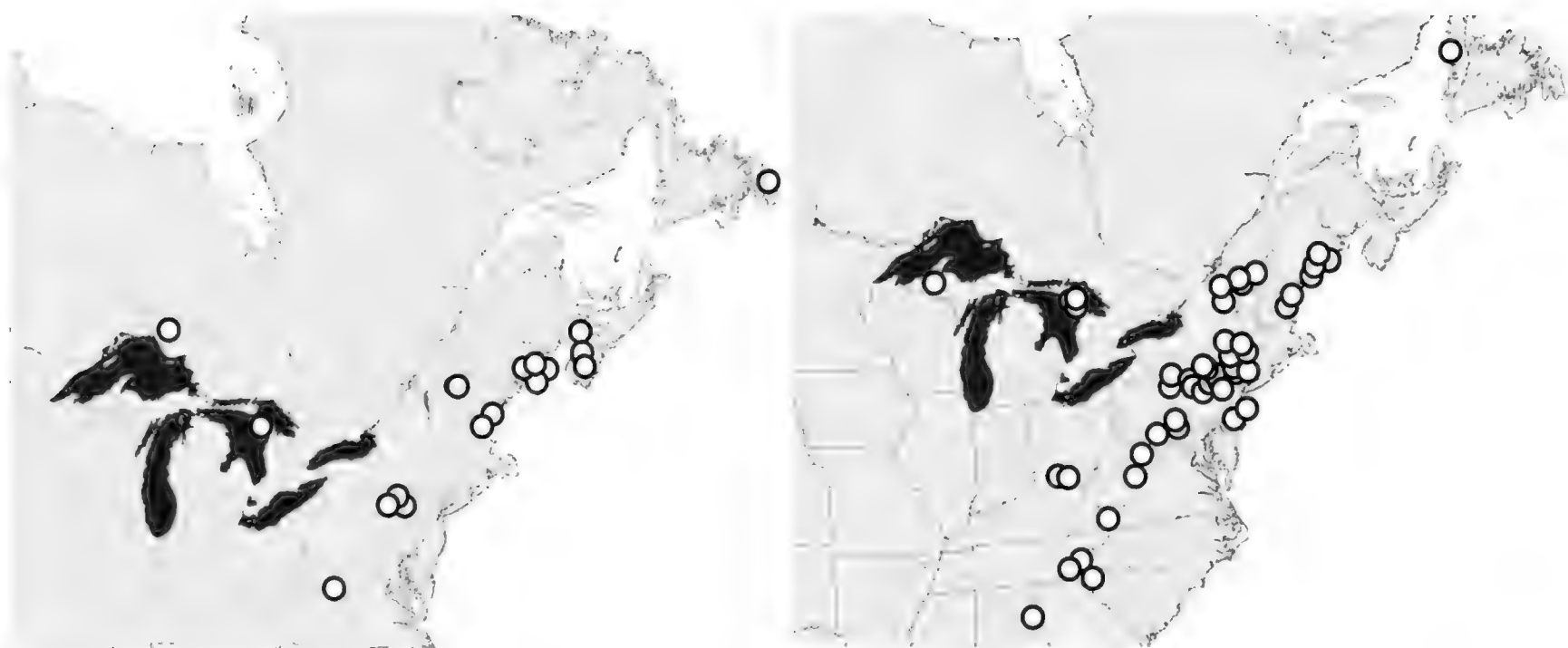


Plate 4. Geographic distributions of *Fuscidea pusilla* (left) *Ropalospora viridis* (right) based on specimens at CANL, MIN, and NY.

SELECTED SPECIMENS EXAMINED. – **CANADA. NEWFOUNDLAND AND LABRADOR.** NEWFOUNDLAND: Avalon Peninsula, Hall's Gullies, 8.ix.2007, on *Betula* log, I.M. Brodo 32092 (CANL). **NOVA SCOTIA.** CUMBERLAND CO.: Cape Chignecto Provincial Park, 15.v.2004, on *Betula*, I.M. Brodo 31437 (CANL). **QUEENS CO.:** Kejmkujic National Park, Grafton Lake, 10.v.1999, on *Betula*, I.M. Brodo 29675 (CANL). **SHELBURNE CO.:** Tobeatic Wilderness Area, 8.v.1999, on *Pinus*, W.R. Buck 35720 (NY). **ONTARIO.** BRUCE CO.: Bruce Peninsula National Park, Halfway Log Dump, 19.ix.2008, on *Betula*, R.C. Harris 54897 (NY, w/ *Ropalospora viridis*). THUNDER BAY DISTRICT: White Lake Provincial Park, 18.vii.1993, on *Alnus*, I.M. Brodo et al. 28616 (CANL). **U.S.A. MAINE.** HANCOCK CO.: trail to Black Mountain, 15.vii.2002, on *Picea*, I.M. Brodo 30735 (CANL), I.M. Brodo 30745A (CANL), I.M. Brodo 30745B (CANL). **WASHINGTON CO.:** Great Wass Island, 15.vi.2010, on *Betula*, J.C. Lendemer 23242-A (NY). **YORK CO.:** Massabesic Experimental Forest, 6.vi.2000, on *Betula*, J.C. Lendemer 22552 (NY). **PENNSYLVANIA.** MONROE CO.: Tobyhanna State Park, 26.vii.2009, on *Picea*, J.C. Lendemer 18565 (NY). **VERMONT.** ESSEX CO.: Quimby Country resort property, 19.v.2008, on *Abies*, R.C. Harris 54610 (NY). **WEST VIRGINIA.** TUCKER CO.: Monongahela National Forest, Olsen's Bog, 22.iv.2001, I.M. Brodo 30360 (CANL).

2. *Ropalospora viridis* (Tønsberg) Tønsberg, Sommerfeltia, 14: 293. 1992.

Fuscidea viridis Tønsberg in Culberson et al., Mycologia 76(1): 156. 1984. TYPE: **NORWAY.**

BUSKERUD: Krødsherad, NE of Ringneselva River, 330 m., *Picea abies* forest, on shaded *Sorbus aucuparia*, T. Tønsberg 6924 (hb. Tønsberg [=BG?], holotype; DUKE, E, TRH, UPS, isotypes [all n.v.]).

PLATES 2A-E & 3 (PAGE 16 & 17).

DESCRIPTION. – The description published by Tønsberg (1992), supplemented by additional information from Ekman (1993), adequately describes the material of *Ropalospora viridis* that was reviewed for this study. It should be noted that the prothallus in *R. viridis* is highly variable (Plate 2) ranging from well developed and brown zoned to poorly developed and shiny. Occasionally the prothallus may even be immersed and indistinct.

CHEMISTRY. – Perlatolic acid. Spot tests: K-, C-, KC- or weakly + fleeting pink, P-, soralia UV+ blue-white.

ECOLOGY AND DISTRIBUTION. – *Ropalospora viridis* is common and widely distributed throughout the Appalachian Mountains and their outliers in eastern North America (plate 4). Disjunct populations occur in the Great Lakes Region and the humid oceanic boreal forests of New England, the Canadian Maritimes, and the Pacific Northwest. The first North American report of this species (Tønsberg 1993) was based on a collection from the Pacific Northwest. The distributional data presented herein serves to correct the statement by Brodo et al. (2001) that *R. viridis* is known only from coastal British Columbia.

The species appears to have a high affinity for hardwood phorophytes (table 2) as out of the 194

collections (210 specimens including duplicates) examined for this study 157 (=81%) were derived from such substrates. *Acer* (62 collections, 36%) and *Betula* (35 collections, 20%) were the most frequent hardwood substrates. Only 33 collections (17% of the total) were derived from coniferous substrates. It should be noted that occasional populations of *Ropalospora viridis* occur on non-calcareous rocks, particularly in high humidity microhabitats.

DISCUSSION. – When Ekman (1993) revised the genus *Ropalospora* he noted the occurrence of *R. viridis* in North America and contrasted it against *R. chlorantha* (Tuck.) S. Ekman. Although *R. chlorantha* is an esorediate species that is typically fertile (Brodo et al. 2001), Ekman (1993) mentioned the existence of rare sorediate thalli of *R. chlorantha* that he believed differed from *R. viridis* in being frequently fertile and in having sparser soralia. In the present study all such thalli have been treated as *R. viridis* as there is no feature to separate the two taxa other than the presence/absence of soralia. In the absence of independent (i.e. molecular) data to the contrary this would seem to be the most parsimonious solution.

In addition to *Fuscidea pusilla*, which is discussed above, the gross morphology of *Ropalospora viridis* (i.e., dark green circular thalli with lighter colored soralia) is likely to cause confusion with *F. arboricola*. That species differs chemically from *R. viridis* in the production of fumarprotocetraric acid (thallus P+ orange-red, UV-) instead of perlatolic acid (thallus P-, UV+ blue-white). No other sorediate species presently known from eastern North America is likely to be confused with these taxa.

SELECTED SPECIMENS EXAMINED. - **CANADA. NEWFOUNDLAND AND LABRADOR:** Island of Newfoundland, Lookout Mountain, 19.vii.2006, on conifer bark, *J.C. Lendemer* 8522 (NY). **ONTARIO.** BRUCE CO.: Bruce Peninsula National Park, Halfway Log Dump, 19.ix.2008, on *Picea*, *R.C. Harris* 54877 (NY), on *Populus*, *R.C. Harris* 54906 (NY), on *Populus*, *R.C. Harris* 54912 (NY). RENFREW CO.: Big Island in Centennial Lake, 6-8.ix.2000, on *Quercus*, *I.M. Brodo* 30292 & *F. Brodo* (CANL). TIMISKAMING DISTRICT: portage between Whitewater Lake and Diabase Lake, 19.viii.2001, on *Betula*, *I.M. Brodo* 30889 (CANL). **PRINCE EDWARD ISLAND:** West Covehead, 22.vii.1977, on *Betula*, *J. Fabiszewski s.n.* (CANL). **QUEBEC.** GATINEAU CO.: Aylmer, N of Pink Rd., 9.vi.1995, on *Acer*, *I.M. Brodo* 28913 & *F. Brodo* (CANL), *I.M. Brodo* 28915 & *F. Brodo* (CANL), *I.M. Brodo* 28919B & *F. Brodo* (CANL). **U.S.A. ALABAMA.** CLEBURNE CO.: Choccolocco Wildlife Management Area, Rattlesnake Mt., 4.vii.2005, on *Acer*, *C.J. Hansen* 1981 (NY). **CONNECTICUT.** FAIRFIELD CO.: Town of Redding, Highstead Arboreum, 9.vi.2005, on *Carya*, *R.C. Harris* 51601 (NY), on *Betula*, *R.C. Harris* 51583 (NY). **MAINE.** HANCOCK CO.: N of ME182, 8 mi W of jct of Unionville Rd., 27.vii.2006, on *Acer rubrum*, *R.C. Harris* 53076A (NY). PENOBSBOT CO.: University Forest, Orono, 4.vi.1986, on *Quercus rubra*, *C. Stubbs s.n.* (NY). WASHINGTON CO.: Petit Manan National Wildlife Refuge, 9.vi.2010, on *Nemopanthus*, *J.C. Lendemer* 22800 (NY). YORK CO.: Massabesic Experimental Forest, 6.vi.2010, on *Acer*, *J.C. Lendemer* 22555 (NY). **MARYLAND.** PRINCE GEORGES CO.: 2 mi SW of Laurel, 23.v.1963, on hardwood, *C.F. Reed* 61820 (NY). **MASSACHUSETTS.** BERKSHIRE CO.: Mt. Greylock State Reservation, 6.v.1995, on *Picea*, *R.C. Harris* 36476 (NY); Town of Hancock, Pittsfield State Forest, 4.vi.2010, on *Betula*, *J.C. Lendemer* 22456 (NY), on *Betula*, *J.C. Lendemer* 22493 (NY). **MICHIGAN.** CHEBOYGAN CO.: S of Hogsback Rd., 26.vii.1974, on *Thuja*, *R.C. Harris* 9234 (NY). HOUGHTON CO.: Ottawa National Forest, 2.5 mi SW of Bob Lake, 16.vii.2004, on *Acer rubrum*, *C.M. Wetmore* 91269 (NY). **MINNESOTA.** COOK CO.: Boundary Waters Canoe Area, 23.ix.1986, on *Salix*, *T.D. Trana* 14680 (MIN). ST. LOUIS CO.: Voyageurs National Park, SW of Jug Island, 19.vii.1979, on *Acer rubrum*, *C.M. Wetmore* 39677 (NY). **NEW JERSEY.** BURLINGTON CO.: Wharton State Forest, 9.x.2004, on *Quercus*, *J.C. Lendemer* 3201 (NY). OCEAN CO.: Long Beach Island State Park, 15.i.2004, on bark, *J.C. Lendemer* 1804 & *S. Joneson* (NY). **NEW YORK.** ESSEX CO.: Memorial Trail off Route 21, sine date, on *Acer*, *S. Sharnoff* 1501.12 (CANL). SUFFOLK CO.: Town of Islip, 31.xii.1978, on *Quercus coccinea*, *F.C. Schlauch s.n.* (NY). WARREN CO.: Crane Mt., 18.ix.1993, on *Populus grandidentata*, *R.C. Harris* 30609 (NY). WESTCHESTER CO.: Angle Fly Preserve, 2.vi.2007, on *Fraxinus*, *R.C. Harris* 23782 (NY). **NORTH CAROLINA.** MACON CO.: Nantahala National Forest, vic. Park Creek Trailhead, 2.v.1997, on *Rhododendron*, *R.C. Harris* 41159 (NY). SWAIN CO.: Great Smoky Mountains National Park, White Oak Branch Trail to jct. w/ Forney Creek Trail, 29.vi.2010, on fallen branch, *J.C. Lendemer* 23523 (NY). TRANSYLVANIA CO.: Gorges State Park, Bearwallow Fields, 11.viii.2005, *J.C. Lendemer* 4589 & *E. Tripp* (NY). **OHIO.** ADAMS CO.: Chaparral Prairie State Nature Preserve, 22.v.2005, on *Carya*, *J.C. Lendemer* 7367 (NY). SCIOTO CO.: Shawnee State Forest, along Pond Lick Run, 21.v.2006, on sandstone, *J.C. Lendemer et al.* 7187 (NY). **PENNSYLVANIA.** BRADFORD CO.: Buchanan State Forest, along Blankley Rd., 17.v.2006, on *Betula*, *R.C. Harris* 52590 (NY). CENTRE CO.: Bald Eagle State Park, Rt. 192, 9.vii.1963, on hardwood, *C.F. Reed* 65219B (NY). LACKAWANNA CO.: Lackawanna State Forest, jct of Tannery Rd. and Fire Line Rd., 7.vii.2008, on rock, *J.C. Lendemer* 12686 (NY). MONROE CO.: SGL 127, Groundhog Knoll, 1.vii.2008, on *Acer*, *J.C. Lendemer* 12284 (NY); Tobyhanna State Park, unnamed drainage below Palen Swamp, 21.vi.2005, on *Betula*, *J.C. Lendemer* 3970 & *J.A. Macklin* (NY), on *Betula*, *J.C. Lendemer* 3971 & *J.A. Macklin* (NY), on *Acer rubrum*, *J.C. Lendemer* 3972 & *J.A. Macklin* (NY). UNION CO.: Bald Eagle State Forest, at Rapid Run, 10.vii.1963, on hardwood, *C.F. Reed* 64178 (NY). WYOMING CO.: SGL 57, summit of Bartlett Mt., 23.vii.2008, on *Betula*, *J.C. Lendemer* 13828 (NY), on rock, *J.C.*

Lendemer 12832 (NY). **TENNESSEE.** BLOUNT CO.: Great Smoky Mountains National Park, Hess Creek, 30.vi.2010, on *Acer*, J.C. *Lendemer 23622* (NY). **VERMONT.** ESSEX CO.: West Mountain Wildlife Management Area, Dennis Pond Wetlands, 18.v.2008, on *Abies*, R.C. *Harris 54507* (NY). LAMOILLE CO.: Molly Bog N of Stowe, 21.ix.1985, on *Acer rubrum*, R.C. *Harris 18175* (NY). **VIRGINIA.** GRAYSON CO.: Jefferson National Forest, 0.5 mi SW of VA16 on VA 741/Homestead Rd., 5.iv.2009, on *Acer*, R.C. *Harris 54032* (NY). **WEST VIRGINIA.** HARDY CO.: George Washington National Forest, along trail from Wolf Gap campground to Tibett Knob, 5.i.1967, on *Quercus*, R.C. *Harris 3568* (NY). PENDLETON CO.: Monongahela National Forest, Lumberjack Trail, 20.iv.2001, on *Acer*, I.M. *Brodo 30331* (NY). TUCKER CO.: Monongahela National Forest, Olsen's Bog, 22.iv.2001, on *Acer rubrum*, R.C. *Harris 44880* (NY). **WISCONSIN.** VILAS CO.: Town of Arbor Vitae, Trout Lake Conifer Swamp State Natural Area, 28.iv.2002, on dead *Populus*, I.M. *Brodo 30662* (CANL).

Comparative Specimens Examined. – **NORWAY. NORDLAND:** Bindal, NE of Djupvikenget, 1.vi.1982, on *Betula*, T. *Tønsberg 6853* (CANL). **SOGN OG FJORDANE:** Førde, Skei, 21.iv.1984, on *Alnus*, *Tønsberg 8693* (CANL).

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LITERATURE CITED

- Brodo, I.M., S. D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven & London. 795 pp.
- Culberson, C.F., and H. Kristinsson. 1970. A standardized method for the identification of lichen products. *Journal of Chromatography*, 46: 85–93.
- Ekman, S. 1993. A taxonomic study of *Ropalospora chlorantha*, and a comparison between *Ropalospora* and *Fuscidea*. *Bryologist*, 96(4): 582-591.
- Fryday, A.M. 2008. The genus *Fuscidea* (Fuscideaceae, lichenized Ascomycota) in North America. *Lichenologist*, 40(4): 295-328.
- Gilbert, O.L., O.W. Purvis, L.H. Skjoldahl, and T. Tønsberg. 2009. *Fuscidea* V. Wirth & Vězda (1972). In: Smith, C.W., A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds). *The Lichens of Great Britain and Ireland*. MPG Books Group, Great Britain. pp.407-411.
- Harris, R.C. and J.C. Lendemer. 2010. A review of *Lecania croatica* (syn. *Catillaria croatica*) in North America. *Opuscula Philolichenum*, 8: 41-49.
- Kantvilas, G. and H.T. Lumbsch. 2010. A new species and a new record of Australian *Scoliciosporum*. *Australasian Lichenology*, 66: 16-23.
- Mietzsch, E., Lumbsch, H.T., Elix, J.A. 1992. *Wintabolites*. Publ. by the authors, Essen. 54 pp.
- Tønsberg, T. 1992. The sorediate and isidiate, corticolous, crustose lichens in Norway. *Sommerfeltia*, 14: 1-331.
- Tønsberg, T. 1993. Additions to the lichen flora of North America. *Bryologist*, 96(1): 138-141.
- Tønsberg, T. 1993a. Additions to the lichen flora of North America II. *Bryologist*, 96(4): 629-630.

A simple clearing technique to aid in the recognition of cilia and rhizinae structure in the Parmeliaceae

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ABSTRACT. – Many authors have had difficulty recognizing true bulbate cilia and rhizinae, the main characteristics for the diagnosis of two genera of small ciliate Parmeliaceae: *Bulbothrix* and *Relicina*. Here it is shown that a simple method of clearing with sodium hypochlorite may be used to solve this problem. This method allows researchers to clear samples of small portions of the thallus margins containing cilia or transverse sections containing rhizinae, without damaging the structures, to reveal important anatomical details necessary for routine identification.

INTRODUCTION

Cilia and rhizinae are structures commonly found in most genera of Parmeliaceae Zenker. According to the Dictionary of Fungi (Kirk et al. 2008), they can be respectively defined as a hair-like outgrowth appearing from the edges of an apothecium or the lichen thallus, and a root-like hair or thread that is an attachment organ for many foliose lichens. Both structures consist of conglutinated hyphae that may be corticate, partially corticate, or entirely ecorticate (Barbosa et al. 2009). With rare exceptions, both cilia and rhizinae are carbonized, black in color and totally opaque when observed with a light microscope. It is impossible to elucidate their structural details without resorting to anatomical sectioning procedures (Hale 1975, Feuerer & Marth 1997, Barbosa et al. 2009).

In the Parmeliaceae, bulbs are enlarged or swollen structures with hollow cavities inside the basal portions of cilia and rhizinae which contain specialized round cells called oil idioblasts and an unidentified oily substance (Hale 1975, Feuerer & Marth 1997). Bulbs can be associated both with rhizinae and the cilia that occur on various portions of the thallus. Bulbs can be moved from the basal portions during the growth of the rhizinae and (more rarely) of the cilia, appearing at different parts of these structures (Benatti 2010).

Despite their relevance today, bulbs have rarely been noticed by most authors since the beginning of the 19th century. They have been interpreted for glandules (e.g., Fée 1825), parasites (e.g., Lynge 1914), and more recently as pycnidia (Hale 1976, Marcelli 1993, Marcano et al. 1996). Only in the second half of the 20th century did they begin to receive proper attention from taxonomists, becoming recognized as a distinct and taxonomically relevant type of thalline structure. Indeed, with the exception of Culberson (1961) almost no other author prior to Hale and Kurokawa (1964) noticed the bulbate shape of the cilia in the species they described. From his comments, Hale was also not fully aware of all the characteristics of bulbate cilia. While explaining much about them when studying the genus *Relicina* (Hale & Kurokawa) Hale (Hale 1975), he did not recognize the bulbate cilia (often without apices) occurring on coronate apothecia and isidia, as well as the laminal ones that occur on some species. Rather he interpreted them as pycnidia (Hale 1975, 1976, Hale & Kurokawa 1964), an interpretation followed also by some later authors (Moralez-Méndez et al. 1995, Marcano et al. 1996).

While bulbs have been misinterpreted by some authors, others (e.g., Elix 1997, Hale 1965, Louwhoff & Elix 2000, Wang et al. 2000) did recognize the partially enlarged cilia or rhizinae bases of some species and placed them in *Bulbothrix* Hale, although with the method explained here these structures

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proved to be not truly bulbate, as recently demonstrated by Benatti and Marcelli (2010). An example of true bulbs on a species thought to have enlarged bases (Hale 1972) was demonstrated by Krog (1993).

The utilization of diaphanization (clearing) processes is fairly common for plant leaves, but almost unheard of in lichen studies except for ascospore clarification (R.C. Harris, pers. comm.). Using sodium hypochlorite for this purpose is routine for plant anatomists who typically utilize variable concentrations, mixing them with other substances, boiling the samples, and other additional procedures (Bersier & Bocquet 1960, Kraus & Arduin 1997). The rough process of diaphanization employed on plant leaves prevent it from being used by lichenologists because it can damage, deform, or destroy delicate lichen thalli. This process is also too slow to be commonly used in routine lichen identification procedures, and is intended to reveal a higher level of detail than is necessary for the identification of the structures presently under consideration.

Sodium hypochlorite is already well known for its clearing property and is routinely used in identifying lichen substances such as the gyrophoric and lecanoric acids. I was curious to know if this substance could also be used to identify and distinguish true bulbate cilia or rhizinae from non bulbate structures. Initial attempts were successful and thus I here present this methodology, which is intended to be useful for routine procedures. It consists of a simple process of diaphanization that neither damages nor deforms structures, enabling their examination in a cost- and time-effective manner.

MATERIALS AND METHODS

The procedure for correctly identifying true bulbs on structures consists of different cuts or the removal of small intact parts of the thalli using a razor blade. The cilia should be removed by cutting a small portion of the margin along the edge of the thallus, while the rhizinae are best observed by making a transverse section of the thallus (as to see each layer separately) preferentially along a densely rhizinate section. Both commercial bleaching hypochlorite solution and those prepared in the laboratory can be used for diaphanization, but due to the presence of stabilizers, the commercial solution often lasts longer when stored. The concentrations I used were 2.0-2.5 % p/p. No significant differences of efficacy were observed between the commercial and laboratorial solutions.

After removal from the thallus, the sample is placed on a slide in a drop of hypochlorite and covered with a coverslip. It is much like the normal procedure of examining ascospores or conidia, only substituting the hypochlorite solution for water. It is important to avoid placing too much pressure on the coverslip, as this may result in damage to the structures of interest.

The hypochlorite will gradually clarify the dark structures of the thallus, like the cilia and rhizinae, without damaging or altering them structurally. Fresh solutions are always recommended, as the efficiency in clarifying is indeed apparent. It is necessary to add hypochlorite periodically, as allowing the sample to dry will cause damage. This process is also useful for viewing the upper cortex, algal layer and medulla, in the case of the transverse sections. Transverse sections of the apothecia, like those of the thallus, can be used to determine the presence of true bulbs instead of pycnidia, but it is also necessary to prevent damage to the bulbs or the oily substances and cells will be lost during the process. Disarticulated ciliate isidia and lacinulae can be easily gathered and also placed upon the slide.

The cilia, rhizinae, and other structures cited above need to be entire for an accurate determination using this method, so they cannot be sectioned or squeezed after the solution is added to the slide. Since this process does not involve flattening the samples it is often very difficult to photograph these structures. To illustrate this problem, the pictures presented here (plate 1) represent some of the best images that I have obtained. Based on my experience, rhizinae are harder to photograph than cilia, especially the bulbate ones, as bulbs normally occur on ramified or thick rhizinae. An image of the rhizinae from *Hypotrachyna tuskiformis* (Elix) Benatti & Marcelli can be seen in Benatti & Marcelli (2010). Despite the inherent difficulty in obtaining photographs for publication, this process makes it easy to observe bulbs through a light microscope. One simply needs to change the light intensity, adjust the condenser(s) and the lens, and zoom in and out to examine the clarified samples and see the characteristics that need to be confirmed.

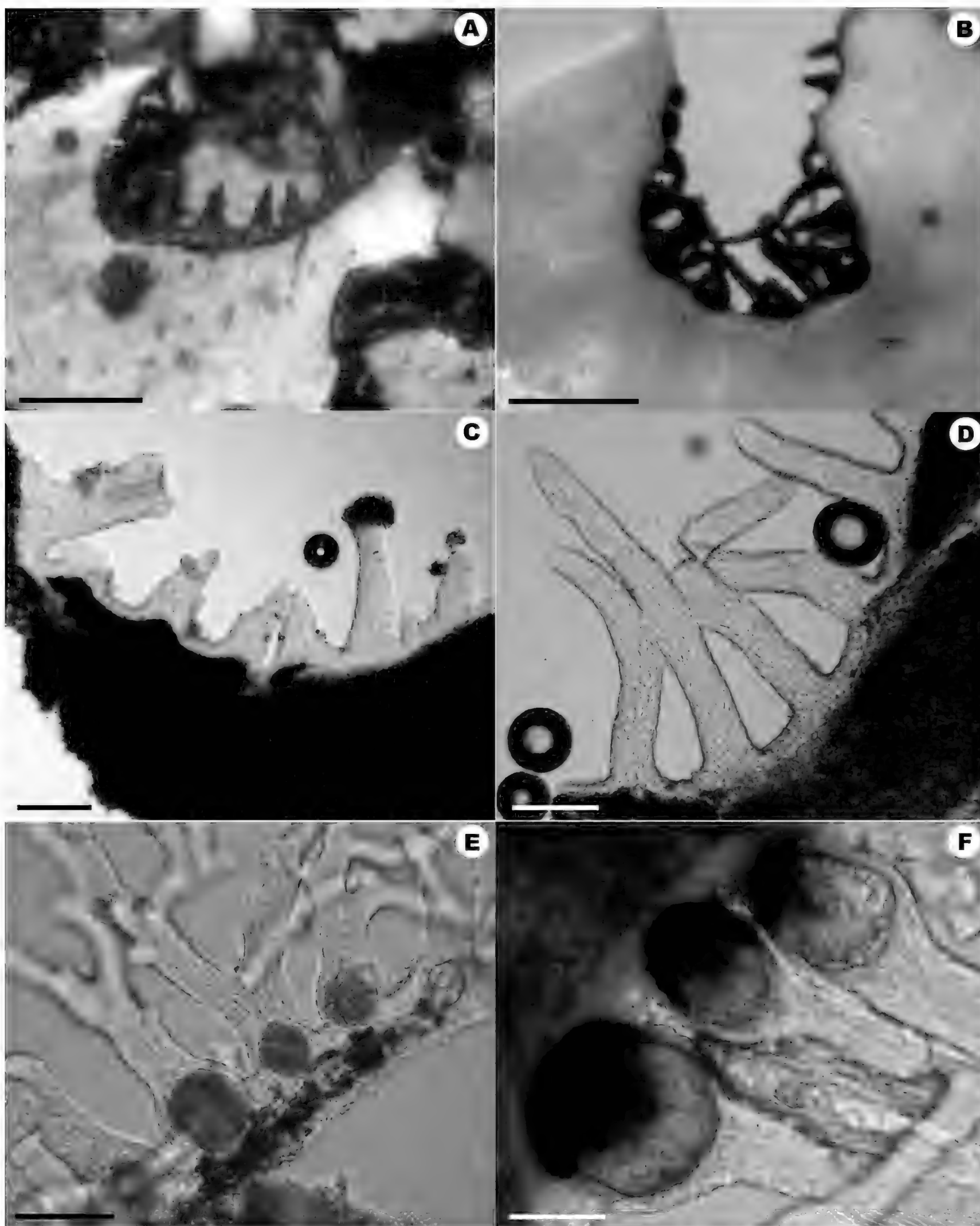


Plate 1. Details of cilia before and after diaphanization with hypochlorite. **A**, detail of cilia with enlarged bases from *Parmelinopsis damaziana* as viewed through a stereomicroscope. **B**, detail of cilia with bulbate bases from *Bulbothrix* sp. as viewed through a stereomicroscope. **C**, the same cilia from *P. damaziana* after 30 min. clarification with hypochlorite; note the thicker parts still clarifying. **D**, simple cilia of *P. subinflata* completely clarified, showing hyphae disposition and no differentiated structures. **E**, bulbate cilia of *B. laevigatula* filled with an oily substance. **F**, detail of bulbate cilia of *Bulbothrix* sp., with the rounded oil idioblasts cells visible amidst the oily substance. The dark, thick basal parts are still clarifying after 20 min. Scales = A & B: 1.0 mm, C: 200 μ m, D-F: 100 μ m.

RESULTS AND DISCUSSION

The use of sodium hypochlorite as a quick tool for clearing fragments and sections of lichen thalli is simple and highly effective. It makes it easy to visualize the anatomical disposition of hyphae and the presence of additional characters inside the cilia and rhizinae when they are present. In the case of bulbs, these structures can even be observed when they are partially damaged, and the oily content is dry or partially lost. Most cilia in Parmeliaceae do not have any special features (Fig. 1D). Cilia that have partially enlarged bases (Figs. 1A & C) are not truly bulbate (Figs 1B, E, F). The bases are not hollow and do not contain any of the anatomical features of those found on *Bulbothrix* and *Relicina* species. The hyphae in such cilia are perceived only as more dense at the start of the growth of the cilium from the marginal line. It should be noted that this is very helpful in distinguishing species that usually have cilia with partially enlarged bases or which are somewhat connected by a thick, massive marginal line (Fig. 1C).

Lichen thalli with true bulbate cilia (Figs. 1B, E, F) may sometimes have small bulbs that are difficult to define as enlarged and/or hollow. Though small, in early stages of development they do contain small amounts of idioblast cells and oil (Fig. 1E & F). This is very important as many species have very small bulbs, ca. 0.05–0.20 mm wide, sometimes only slightly wider than the cilium apex (Fig 1E), while those without bulbate bases show no characteristics other than the agglutinated hyphae (Fig. 1D).

It should be recognized that other substances commonly used in lichen species determination, such as potassium hydroxide (KOH), will not influence hypochlorite activity. However in the case of species containing substances that commonly react with KOH, such as norstictic and salazinic acids, the addition of KOH will cause the sample to stain reddish and make visualization difficult. Even in species that normally contain substances that react to the C test, the substance is not typically concentrated enough to stain the sample, and any reaction will be fleeting. The hypochlorite solutions used for this method should not be further diluted with water. Adding water will weaken the process of clarification, and delay or even preclude the substances from clarifying the samples. Thicker and darker structures may require more time and repeated addition of hypochlorite. Although this process is gradual, continuously adding hypochlorite will not wash the dark pigments. While some thin structures are cleared almost instantly, or take just a few minutes, thicker ones take several minutes to almost half an hour. Examples of cleared thin cilia in *Parmelinopsis subinflata* (Hale) Benatti & Marcelli and thick cilia in *Parmotrema yunnanum* (Sheng L. Wang, J.B. Chen & Elix) Marcelli & Benatti may be found in Benatti and Marcelli (2010).

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LITERATURE CITED

- Barbosa, S.B, M.P. Marcelli, and S.R. Machado. 2009. Evaluation of different protocols for anatomical studies in Parmeliaceae (lichenized Ascomycota). *Micron*, 40: 218-225.
- Benatti, M.N. 2010. Revisão taxonômica do gênero *Bulbothrix* Hale (Parmeliaceae, Ascomycota liquenizados) [Doctoral Thesis]. Instituto de Botânica. São Paulo. 401 pp.
- Benatti, M.N. and M.P. Marcelli. 2010. Four Parmeliaceae species excluded from *Bulbothrix*. *Mycotaxon*, 111: 387-401.
- Bersier, J.D and D. Bocquet. 1960. Les méthodes d'éclaircissement em vascularisation et em morphogénie végétales comparées. *American Journal of Botany*, 48(2): 168-174.
- Culberson, W.L. 1961. The *Parmelia quercina* group in North America. *American Journal of Botany*. 48(2): 168-174.
- Elix J.A. 1997. Further new species in the lichen family Parmeliaceae (Ascomycotina) from Australasia. *Mycotaxon*, 65: 481-491.
- Fée, A.L.A. 1825. Essai sur les cryptogames des écorces exotiques officinales. Paris. 167 pp.
- Feuerer, T. and C. Marth. 1997. Anatomy of pseudocyphellae and bulbate cilia in Parmeliaceae. *Mitteilungen aus dem Institut für Allgemeine Botanik in Hamburg*, 27: 101-107.
- Hale, M.E. 1965. Six new species of *Parmelia* from southeast Asia. *Journal of Japanese Botany*, 40(7): 199-205.
- Hale, M.E. 1972. Six new species of *Parmelia* from Africa. *Phytologia*, 23: 343-349.
- Hale, M.E. 1975. A monograph of the lichen genus *Relicina* (Parmeliaceae). *Smithsonian Contributions to Botany*, 26: 1-32.
- Hale, M.E. 1976. A monograph of the lichen genus *Bulbothrix* Hale (Parmeliaceae). *Smithsonian Contributions to Botany*, 32: 1-29.

- Hale, M.E. and S. Kurokawa. 1964. Studies on *Parmelia* subgenus *Parmelia*. Contributions from the United States National Herbarium, 36(4): 121-191.
- Kirk, P.M., P.F. Cannon, D.W. Minter, and J.A. Stalpers. 2008. Ainsworth & Bisby's Dictionary of Fungi. 10th ed. CABI International. Egham. 640 p.
- Kraus, J.E. and M. Arduin. 1997. Manual básico de métodos em morfologia vegetal. Editora da Universidade Rural, Rio de Janeiro.
- Krog, H. 1993. *Parmelina enormis* (Hale) Hale is *Bulbothrix enormis* (Hale) Krog comb. nov. Lichenologist, 25(3): 299-300.
- Louwhoff, S.H.J.J. and J.A. Elix. 2000. Five new species in the lichen family Parmeliaceae (Ascomycotina) from Grande Terre, New Caledonia. Mycotaxon, 75: 195-203.
- Lynge, B. 1914. Die Flechten der ersten Regnellschen Expedition. Die Gattungen *Pseudoparmelia* gen. nov. und *Parmelia* Ach. Arkiv för Botanik, 13(13): 1-172.
- Morales-Méndez, A., V. Marcano, L. Galiz, S. Mohali, and E. Palacios-Prü. 1995. *Bulbothrix amazonensis* sp. nov., a new species of Parmeliaceae (Lecanorales) from Venezuelan Amazonia. In: Daniels FJA, Schulz M, Peine J. (eds.). Flechten Follmann. Contributions to lichenology in Honour of Gerhard Follmann. Geobotanical and Phytotaxonomical Study Group, Botanical Institute, University of Cologne, Cologne, pp. 281-286.
- Marcano, V., S. Mohali, E. Palacios-Prü, and A. Morales-Méndez. 1996. The lichen genus *Bulbothricella*, a new segregate in the Parmeliaceae from Venezuela. Lichenologist, 28(5): 421-430.
- Marcelli, M.P. 1993. Pequenas *Parmelia* s.l. Ciliadas dos Cerrados Brasileiros. Acta Botanica Brasilica, 7(2): 25-70.
- Wang, S-L., J-B. Chen, and J.A. Elix. 2000. New species of Parmeliaceae (lichenized Ascomycotina) from China. Mycotaxon, 76: 293-298.

A new member of the genus *Silobia* (Acarosporaceae) from North America

KERRY KNUDSEN¹

ABSTRACT. – The newly described genus *Silobia* is accepted. *Acarospora hassei* is discussed and transferred to *Silobia*. A key to the genus *Silobia* in North America is presented.

KEYWORDS. – Maritime lichens, nomenclature, taxonomy.

INTRODUCTION

The genus *Silobia* M. Westb. & Wedin was recently described to accommodate the *Acarospora smaragdula* group (Westberg et al. 2011, Westberg & Wedin 2011). Seven species from Sweden were initially recognized in the new genus. One species that is apparently endemic to North America, *A. hassei* Herre, was not included in the revision, though it was recognized as a member of the *A. smaragdula* group (Knudsen 2007a). Here *A. hassei* is transferred to *Silobia*. *Acarospora dispersa* H. Magn., a species the author also considered a member of the *A. smaragdula* group (Knudsen 2007a), appears to be closely related to *A. sphaerosperma* R.C. Harris & K. Knudsen (Knudsen et al. 2011). This species is presently being revised and it is provisionally excluded from *Silobia*.

The genus *Silobia* is phylogenetically distinct from *Acarospora* A. Massal. (Crewe et al. 2006, Wedin et al. 2009). *Silobia* species share a similar gestalt, which is hard to describe but is easily recognized subjectively through familiarity with the genus (see photographs in Westberg et al. (2011)). A suite of taxonomic characters distinguish *Silobia*: the presence of an interrupted algal layer, high hymenium, narrow paraphyses (usually <2 µm), narrow ellipsoid ascospores (often 2 µm or less in width), short conidia, and the presence of norstictic acid or absence of secondary metabolites. None of these characters are individually unique to *Silobia* in the broader context of the family Acarosporaceae, but all the characters are present in *Silobia* species.

THE SPECIES

Silobia hassei (Herre) K. Knudsen, comb. nov.

Mycobank #561200.

Basionym. *Acarospora hassei* Herre, Proc. Wash. Acad. Sci., 12: 128. 1910. TYPE: **U.S.A. CALIFORNIA.** SANTA CRUZ CO.: Santa Cruz Mountains, Castle Rock, 3000 ft., 16.vi.1906, on sandstone, A.C.T.W. Herre 757 (FH!, lectotype, selected by Knudsen (2004); FH! NY!, isoelectotypes).

FIGURE 1 (PAGE 28).

Discussion. – For a full description of *Silobia hassei* see Knudsen (2007a). It was treated as *Acarospora smaragdula* var. *lesdainii* (Harmand ex A.L. Smith) H. Magn. by Magnusson (1929), Clauzade and Roux (1982), and initially by the author (Knudsen 2004). The holotype of *A. lesdainii* Harmand ex Smith was found to contain norstictic acid and is a synonym of *S. smaragdula* (Wahlenb.) M. Westb. &

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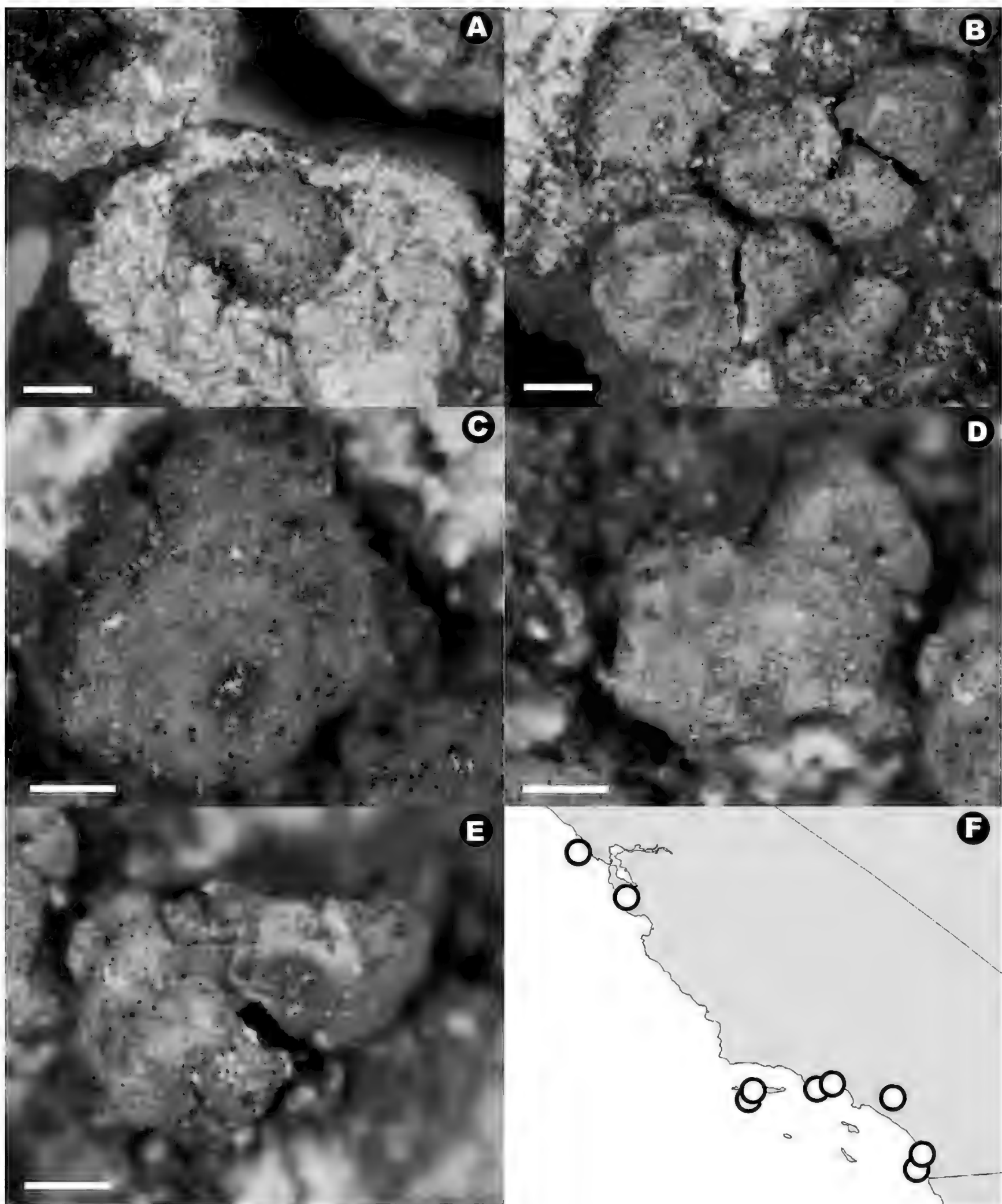


Figure 1. *Silobia hassei*. A-E, thallus and apothecia from islectotype (NY). F, geographic distribution based on specimens at FH, NY, and UCR. Scales = A & B: 1.0 mm, C-E: 0.5 mm.

Wedin (Westberg et al. 2011). While *S. smaragdula* is rich in norstictic acid, readily forming crystals in KOH, *S. hassei* lacks any secondary metabolites. Generally, *S. smaragdula* in North America is pale brown usually with 5 to 8 apothecia less than 0.35 mm in diameter with a brown stain around them (see Fig. A in Westberg et al. (2011)). *Silobia hassei* is usually darker brown than *S. smaragdula*, has mostly 1 to 3 apothecia to 0.9 mm in diameter and without a brown stain around them. Like *S. smaragdula*, *S. hassei* is epilithic and dispersed on hard substrates. But unlike *S. smaragdula*, on crumbling sandstone *S. hassei* can become chasmolithic (growing intermixed with the uppermost layer of substrate particles) and develops a contiguous areolate thallus with single apothecia. This form is particularly common on Castro Crest in the Santa Monica Mountains (Knudsen 2004).

Silobia hassei appears to be a rare species of the central and southern California coast, occurring from Point Reyes (north of San Francisco) to Point Loma in San Diego, as well as on Santa Rosa Island, on sandstone and silicate substrates (UCR Herbarium 2011). All known locations are on the Pacific Plate, a geologically young addition to the North American continent. Interestingly, on the Pacific Plate, it fills the coastal niche that *S. smaragdula* occupies in Chile, Oregon, and northeastern North America (Knudsen 2007b; Knudsen et al. in rev.).

Based on revisionary work currently in progress, *Acarospora dispersa* is no longer recognized as occurring in California (Knudsen 2007a) and is considered a species of eastern North America (with a possible disjunct population in the San Francisco Peaks in Arizona). Specimens from California identified as *A. dispersa* have been revised as *S. hassei*. A key to the genus *Silobia* in North America is presented below.

KEY TO SILOBIA IN NORTH AMERICA

For descriptions of species see Westberg et al. (2011) and Knudsen (2007a).

- 1. Norstictic acid present *Silobia smaragdula*
- 1. Norstictic acid absent 2
 - 2. On seashore rocks (north Atlantic coast) *Silobia rhagadiza*
 - 2. Not on seashore rocks 3
 - 3. Apothecia elevated in parathecial crown, often bullate *S. scabrida*
 - 3. Apothecia not elevated in parathecial crown, not bullate *S. hassei*

ACKNOWLEDGEMENTS

I thank the reviewers, Martin Westberg (S) and Mats Wedin (S). I thank Bill Buck and Dick Harris as well as James Lendemer and Andy Moroz for their hospitality and assistance during my visit to New York Botanical Garden. I thank FH for the loan of the lectotype of *Acarospora hassei* during this study and Dick Harris for sharing with me his valuable work on *Acarospora* in the Ozarks. This research was supported by an Academic Fellowship of the Santa Monica Mountains Fund.

LITERATURE CITED

- Clauzade, G., C. Roux and R. Rieux. 1981[1982]. Les *Acarospora* de l'Europe occidentale et de la region méditerranéenne. Bulletin du Musé d'Histoire Naturelle de Marseille, 41: 41–93.
- Crewe, A.T., O.W. Purvis and M. Wedin. 2006. Molecular phylogeny of Acarosporaceae (Ascomycota) with focus on the proposed genus *Polysporinopsis*. Mycological Research, 110: 521–526.
- Knudsen, K. 2004. A preliminary study of *Acarospora smaragdula* var. *lesdainii* in California. Opuscula Philolichenum, 1: 21–24.
- Knudsen, K. 2007a[2008]. *Acarospora*. In T.H. Nash III, C. Gries and F. Bungartz (eds.) Lichen Flora of the Greater Sonoran Desert Region, vol. 3: 1–38. Lichens Unlimited, Tempe, AZ.
- Knudsen, K. 2007b. *Acarospora smaragdula* in North America. Evansia, 24: 94–96.
- Knudsen, K., A. Flakus and M. Kukwa. In rev. A contribution to the study of Acarosporaceae in South America. The Lichenologist.
- Knudsen, K., J.C. Lendemer and R.C. Harris. 2011. Studies in lichens and lichenicolous fungi – no. 8: miscellaneous notes on species from eastern North America. Opuscula Philolichenum, 45-75.
- Magnusson, A.H. 1929. A monograph of the genus *Acarospora*. Kungliga Svenska Vetenskapsakademiens Handlingar, ser. 3, 7: 1–400.
- UCR Herbarium. 2011. http://sanders5.ucr.edu/lichensflat_index.php Accessed March, 2011.

- Wedin, M., M. Westberg, A.T. Crewe, A. Tehler and O.W. Purvis. 2009. Species delimitation and evolution of metal bioaccumulation in the lichenized *Acarospora smaragdula* (Ascomycota, Fungi) complex. *Cladistics*, 25: 161–172.
- Westberg, M., A.T. Crewe, O.W. Purvis and M. Wedin. 2011. *Silobia*, a new genus for the *Acarospora smaragdula* complex, and a revision of the group in Sweden. *The Lichenologist*, 43: 7-25.
- Westberg, M. and M. Wedin. 2011. The identity of *Trimmatothelopsis versipellis* (Nyl.) Zschacke. *The Lichenologist*

Acarospora benedarensis: a rare terricolous maritime lichen from Ireland, Scotland, and Wales

KERRY KNUDSEN¹ & HOWARD FOX²

ABSTRACT. – *Acarospora benedarensis*, a rare terricolous lichen endemic to Ireland, Scotland and Wales, is discussed. It is recognized as having a much higher hymenium than described in the protologue with correspondingly tall asci. It is probably not a member of the new genus *Silobia* but further study of its systematic position is needed. A lectotype is also designated.

KEYWORDS. – *Acarospora rhizobola*, biological soil crusts, hypothallus, maritime lichens, morphology, nitrophiles, rhizohyphae, *Silobia rhagadiza*, taxonomy.

INTRODUCTION

In 1913, in “The Maritime and Marine Lichens of Howth” in the *Scientific Proceedings of the Royal Dublin Society*, Matilda C. Knowles described *Acarospora benedarensis* M. Knowles from Howth Head in Ireland near Dublin. The species is rare in nature (Fletcher et al. 2009). While studying at the United States National Herbarium (US), the first author found a small but excellent specimen of *A. benedarensis* collected on Howth Head by Knowles and originally given to the American lichenologist C.C. Plitt. The mature apothecia were well developed as was the thallus, allowing for some new observations. The current description (Fletcher et al. 2009) is adequate for identification, except for hymenial height, which in mature apothecia is much higher, and ascus size is lacking.

DISCUSSION

Knowles discovered *Acarospora benedarensis* on lower “earth banks” of white fine clay forming steep lower slopes along the cliffs on the southwest coast of Howth Head. The distinct white soil type of Howth Head is Hippy Hole Formation sediments of Cambrian origin (van Lunsen & Max 1995) and this habitat is exposed to salt spray. She further described the community in which *A. benedarensis* occurs as follows (Latin names for plants inserted from Doogue et al. 1998):

“Scurvy-grass (*Cochlearia officinalis* L.), Sea Spurry (*Spergularia rupicola* Lebel ex le Jolis), Sea Lavender (*Limonium humile* Miller), Thrift (*Armeria maritima* (Miller) Willd.), Plantains (*Plantago coronopus* L. and *Plantago maritima* L.) and Sea Campion (*Silene uniflora* Roth) are abundant. Bare patches of ground, sometimes of considerable area, occur here and there by the paths, and among flowering plants. The soil seems to be derived chiefly from the disintegration of very friable and finely laminated shales, masses of which crop out above the surface in many places. It is a stiff, almost white clay, very powdery in dry weather, and very sticky and close in wet weather. These apparent bare patches are covered with a kind of broken skin formed of crustaceous lichens, grey, green, yellow, black, and brown, all mingled together in some places, but in others forming large colonies of pure growth.” (Knowles 1913).

Acarospora benedarensis was “one of the most abundant lichens” in these biological soil crusts in “the driest and sunniest locations” often forming large, continuous, and exclusive patches. The thallus of *A. benedarensis* is an aggregation of areoles, 1-3 mm in diameter, of various shades of brown, powdered with

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white soil in the specimen the first author examined. Some of the areoles are subsquamulose with a distinct lobulation along the edges though they remain broadly attached. The apothecia are easy to see after wetting the areoles. They have dark concave discs in usually distinct raised parathecial crowns, one or more per areole. The cortex is distinctly paraplectenchymatous. The algal layer is not consistently interrupted by hyphal bundles and only one bundle was observed in the specimen studied. Magnusson (1929) too reported it as a variable character. The hymenium was described in the protologue as 100 μm high and no measurements were given for the asci (Knowles 1913). The original measurement must have been based on an immature hymenium and has been repeated from the protologue rather than observed by later writers (e.g., Roux 2007). The first author observed hymenial heights of 180-200 μm in a mature apothecium with asci 150-160 x 20 μm which were not fully matured. Magnusson (1929) also observed a high hymenium, up to 170 μm high. The paraphyses are thin, mostly 1-1.5 μm in diameter, with infrequent branching. The ascospores are mostly 3-5 x 1.5 μm , subglobose to broadly ellipsoid. The first author saw few mature ascospores himself.

The areoles lack a true lower surface and the medullary hyphae are continuous with an endosubstratal hypothallus composed of both thin hyphae and thicker, distinctly anastomosing rhizohyphae. The hypothallus gives rise to new areoles that are closely spaced. This type of hypothallus is common among terricolous *Acarospora* A. Massal. and occurs for instance in the cosmopolitan *A. schleicheri* (Ach.) A. Massal. (Knudsen 2007) as well *A. fuscescens* H. Magn. (Knudsen 2008), *A. thelococcoides* (Nyl.) Zahlbr. (Knudsen 2007), and *A. orcuttii* K. Knudsen (Knudsen 2010) in western North America. These species are obligatory terricolous crusts and only a few populations have been found on disintegrating soft rock that allows the development of the extensive hypothallus. Knowles (1913) wrote an excellent description of the hypothallus of *A. benedarensis*: “It is a very efficient earth-builder. The undersurface of the thallus has no defining layer, and the hyphal filaments penetrate the fine powdery soil, ramifying and branching in all directions, and enclosing particles of soil in their tissue.”

Acarospora benedarensis is endemic to Ireland, Scotland and Wales. Fletcher et al. (2009) reported it from Howth Head as well as the Welsh Islands (Anglesey and Bardsey) and Scotland (Angus and Orkney). It had been reported prior to 2000 near the Blasket Islands off western Ireland (Davey 2008), but this may be a misidentified *Silobia* M. Westb. & Wedin with norstictic acid. Clearly the species is rare. Fletcher et al. (2009) reported it occurs on clay “compacted by sheep-trampling and on the floor of recesses used by them for shelter” in Wales. It is likely that *A. benedarensis* is a nitrophile and is being fertilized by the sheep. It appears to be more successful in disturbed terricolous habitats than most terricolous *Acarospora*, which are easily extirpated by disturbance (Knudsen 2010; Knudsen et al. in rev.). Knowles never mentioned sheep at the type locality or in connection with the species, and there are no sheep on Howth Head.

Acarospora benedarensis was considered part of the *A. smaragdula* complex by Clauzade and Roux (Clauzade et al. 1981) and was recognized as one of many varieties of *A. smaragdula*. Roux (2007) recently recognized it as a distinct species, apparently still considering it part of the *A. smaragdula* complex. During the recent revision of this group (Westberg et al. 2011; Westberg & Wedin 2011), which led to the recognition of the new genus *Silobia*, modern specimens of *A. benedarensis* were not available for sequencing and only a poor type specimen was seen. Westberg et al. (2011) speculated it might be a synonym of *Sarcogyne rhagadiza* (Nyl.) M. Westb., the name applied to the taxon previously included in *A. amphibola* Wed. by Magnusson (1929). The presence of a hypothallus suggests that *A. benedarensis* does not normally occur on rock while *S. rhagadiza* does. *Acarospora benedarensis* also has a higher hymenium than *S. rhagadiza* (180-200 μm vs. 110-160 μm) with taller asci (150-160+ μm vs. 105 μm) (Westberg et al. 2011). Both species occur in the same maritime habitat in Ireland according to Knowles (1929). Above the high tide level *A. benedarensis* grew especially on cliff tops and steep earth banks though it was still exposed to salt spray. *Silobia rhagadiza* (treated as *A. amphibola* by Knowles) was “not uncommon on schistose rocks, within reach of the waves, at the base of the earth cliffs, Stella Maris and Broad Strand, Howth, 1911”.

Acarospora benedarensis should not be considered a member of *Silobia* until an analysis of molecular data has been performed to confirm its position in the genus. Based on a morphological analysis, the only characters it shares with the genus *Silobia* are narrow paraphyses and a high hymenium. These characters are not restricted to *Silobia* though they are elements of its unique suite of characters. *Acarospora benedarensis* apparently lacks a distinct and consistent interrupted algal layer, a character occurring in all *Silobia* species. Nonetheless, other specimens should be checked for an interrupted algal

layer, possibly developing in older areoles. Interrupted algal layers do occur in other *Acarospora* species, for instance *A. cervina* A. Massal. or *A. badiofusca* (Nyl.) Th. Fr. s. lat. from central Europe.

Conidia (4-5 x 1 µm) were observed in *Acarospora benedarensis*, confirming the report of long conidia in the protologue (Knowles 1913). This is not a common conidium size in *Acarospora*. Interestingly the high hymenium and long conidia are shared with two other terricolous *Acarospora* with rhizohyphae, *A. rhizobola* (Nyl.) Alstrup (Fletcher et al. 2009) and *A. terricola* H. Magn. (Knudsen 2007). *Acarospora rhizobola* is a member of the Acarosporomycetidae but is only distantly related to *Silobia* (Westberg, pers. comm.) based on molecular data. *Acarospora terricola* also has scattered hyphal bundles penetrating the algal layer that can only be easily seen in mature specimens (Knudsen 2007).

The etymology of the name has Ben Edair, the Irish name for Howth as its basis. This name is well known to Dublin commuters and is attested on the front of Dublin buses on a bilingual caption showing the destination of bus routes 31 and 31B which runs many times daily from the city centre.

Here we select a lectotype from five boxes of specimens (3 types) collected by Knowles on a single sheet at the herbarium of the Dublin National Museum (DBN). A modern collection should eventually be selected as the epitype and sequenced. A synonymy for the name is presented below:

Acarospora benedarensis Knowles, Sci. Proc. Royal Dublin Soc., 14(6): 131. 1913. TYPE: **IRELAND**. DUBLIN CO.: Howth Head, Earlscliffe, vi.1912, on earthbanks “great beds among tussocks of thrift, only other vegetation”, *M.C. Knowles, s.n.* (DBN!, lectotype **designated here**).

Acarospora smaragdula var. *benedarensis* (Knowles) Clauzade & Cl. Roux, Bulletin du Musé d'Histoire Naturelle de Marseille, 41: 70. 1982.

Additional specimen examined. – **IRELAND**. HOWTH CO.: Dublin, Earlescliffe, 1910-1913, *M.C. Knowles s.n.* (US-01028690 [ex-hb. C.C. Plitt]).

As an aside, the first author was unfamiliar with the work of the Irish lichenologist Matilda C. Knowles (1864-1933) until he studied her species. He was deeply impressed by the quality of her observations as well as her skill as a lichenologist. Her discussion of maritime *Verrucaria* on Howth Head is especially interesting (Knowles 1913). She had an abiding interest in vascular plants from an early age but did not begin taking science courses until 1907. At that time “she became... a “Temporary” Assistant in the herbarium of the Science and Art (now National) Museum, where she remained till her retirement twenty-six years later, being in charge of the botanical collections for the last ten years (1923-1933), following the retirement of Prof. T. Johnson. The phanerogams were her study until 1909, when her association with Miss Lorrain Smith on the Clare Island Survey caused her to attack vigorously the large group of lichens which hitherto, though collected by many able workers, had not been subjected to topographical or ecological study. During the remaining portion of her life, lichens occupied first place, her crowning work being “The Lichens of Ireland” (Knowles 1929), which detailed the distribution of over 800 species.”(Praeger 1948).

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LITERATURE CITED

- Clauzade, G., C. Roux and R. Rieux. 1981[1982]. Les *Acarospora* de l’Europe occidentale et de la region méditerranéenne. Bulletin du Musé d’Histoire Naturelle de Marseille, 41: 41–93.
- Davey, S. 2008. *Acarospora benedarensis*. <http://www.habitas.org.uk/lichenireland/species.asp?item=432868>
- Doogue D.A., D. Nash, J. Parnell, S. Reynolds and P. Wyse Jackson. 1998. Flora of County Dublin. Dublin Naturalists Field Club, Dublin. 558pp.
- Fletcher, A., P.W. James and O.W. Purvis. 2009. *Acarospora* A. Massal. (1852) In: Smith, C.W., A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.) The Lichens of Great Britain and Ireland, pp.125–132. London: British Lichen Society.

- Knowles, M.C. 1913. The maritime and marine lichens of Howth. Scientific Proceedings of the Royal Dublin Society 14: 79–143. [Download at Google Books <http://books.google.com>]
- Knowles, M.C. 1929. The lichens of Ireland. Proceedings of the Royal Irish Academy, Section B, 38: 179–434. [Available on Jstor.]
- Knudsen, K. 2007[2008]. *Acarospora*. In: Nash III, T.H., C. Gries & F. Bungartz (eds.) Lichen Flora of the Greater Sonoran Desert Region, Vol. 3: 1–38. Lichens Unlimited, Tempe, AZ.
- Knudsen, K. 2008. *Acarospora fucescens* (Acarosporaceae), a little known species of western North America. *Evansia*, 25(4): 82–84.
- Knudsen, K. 2010. *Acarospora orcuttii* (Acarosporaceae), a rare terricolous lichen from southern California. *The Bryologist*, 113(4): 713–716.
- Knudsen, K., A. Flakus and M. Kukwa. In review. A Contribution to the Study of Acarosporaceae in South America. *The Lichenologist*.
- Magnusson, A.H. 1929. A monograph of the genus *Acarospora*. Kungliga Svenska Vetenskapsakademiens Handlingar, ser. 3, 7: 1–400.
- Praeger, R.L. 1948. Some Irish Naturalists: A Biographical Notebook. National Herbarium. <http://www.botanicgardens.ie/herb/books/inetok.htm>. Accessed March, 2011.
- Roux, C. 2007[2008]. Likenoj de Okcidenta Eŭropo. Suplemento 4a: eltiraĵoj 2 (extraits 2). Bulletin d'Informations de l'Association Française de Lichénologie, 32(2): 5–36.
- van Lunsen, H.A. and M.D. Max. 1975. The geology of Howth and Ireland's Eye, Co. Dublin. *Geological Journal*, 10(1): 35–58.
- Westberg, M., A.T. Crewe, O.W. Purvis and M. Wedin. 2011. *Silobia*, a new genus for the *Acarospora smaragdula* complex, and a revision of the group in Sweden. *The Lichenologist*, 43(1): 7–25.
- Westberg, M. and M. Wedin. 2011. The identity of *Trimmatothelopsis versipellis* (Nyl.) Zschacke. *The Lichenologist*.

Punctelia eganii, a new species in the *P. rudecta* group with a novel secondary compound for the genus

BRENDAN P. HODKINSON¹ & JAMES C. LENDEMER²

ABSTRACT. – *Punctelia eganii*, a lichen species from southeastern North America, is described as new to science. This species is known from a single locality in Alabama, U.S.A, and is morphologically identical to *P. rudecta*, differing in the production of lichexanthone, a secondary compound previously unknown in the genus. The use of secondary chemistry in the species-level taxonomy of *Punctelia* is discussed.

INTRODUCTION

The genus *Punctelia* Krog represents a distinctive group of parmelioid species distinguished by having small pseudocyphellae ('punctae') in the upper cortex (Krog 1982). The genus has recently been shown to exhibit a greater degree of alpha-diversity in eastern North America than previously reported (Lendemer & Hodkinson 2010, Wilhelm & Ladd 1987). Species in the genus are distinguished by a combination of characters including underside color, secondary chemistry, presence/absence of scrobiculae on the upper surface, and diaspore-type (Lendemer & Hodkinson 2010). A population that is morphologically identical to *P. rudecta* (Ach.) Krog, but has an alternative secondary chemistry was recently discovered and is described here as *P. eganii*. This represents the first reported occurrence of lichexanthone in the genus *Punctelia*.

MATERIALS AND METHODS

Specimens were studied dry using a Bausch & Lomb StereoZoom 7 dissecting microscope and subjected to chemical analysis using standard spot tests (reagents are abbreviated following Brodo et al. (2001)) and Thin Layer Chromatography (TLC). TLC was carried out by R.S. Egan at OMA following Culberson & Kristinsson (1970). Images were captured using an Olympus DP20 digital camera with Microsuite Special Edition. The illustration was prepared using Adobe Photoshop. Due to the limited material available, measurements are expressed simply as ranges of observed values.

THE NEW SPECIES

***Punctelia eganii* Hodkinson & Lendemer sp. nov.**

Mycobank #561203.

PLATE 1 (PAGE 36).

Sicut *Punctelia rudecta* sed lichexanthonium continens.

TYPE: U.S.A. ALABAMA. MONROE CO.: Haines Island Park, forest trail near boat ramp, public recreation area operated by the U.S. Army Corps of Engineers, 20 mi N of Monroeville, along the Alabama River, 50 ft. elev., beech-*Magnolia* forest, 31.vii.2003, on bark, *R.S. Egan 16197-A* (NY, holotype).

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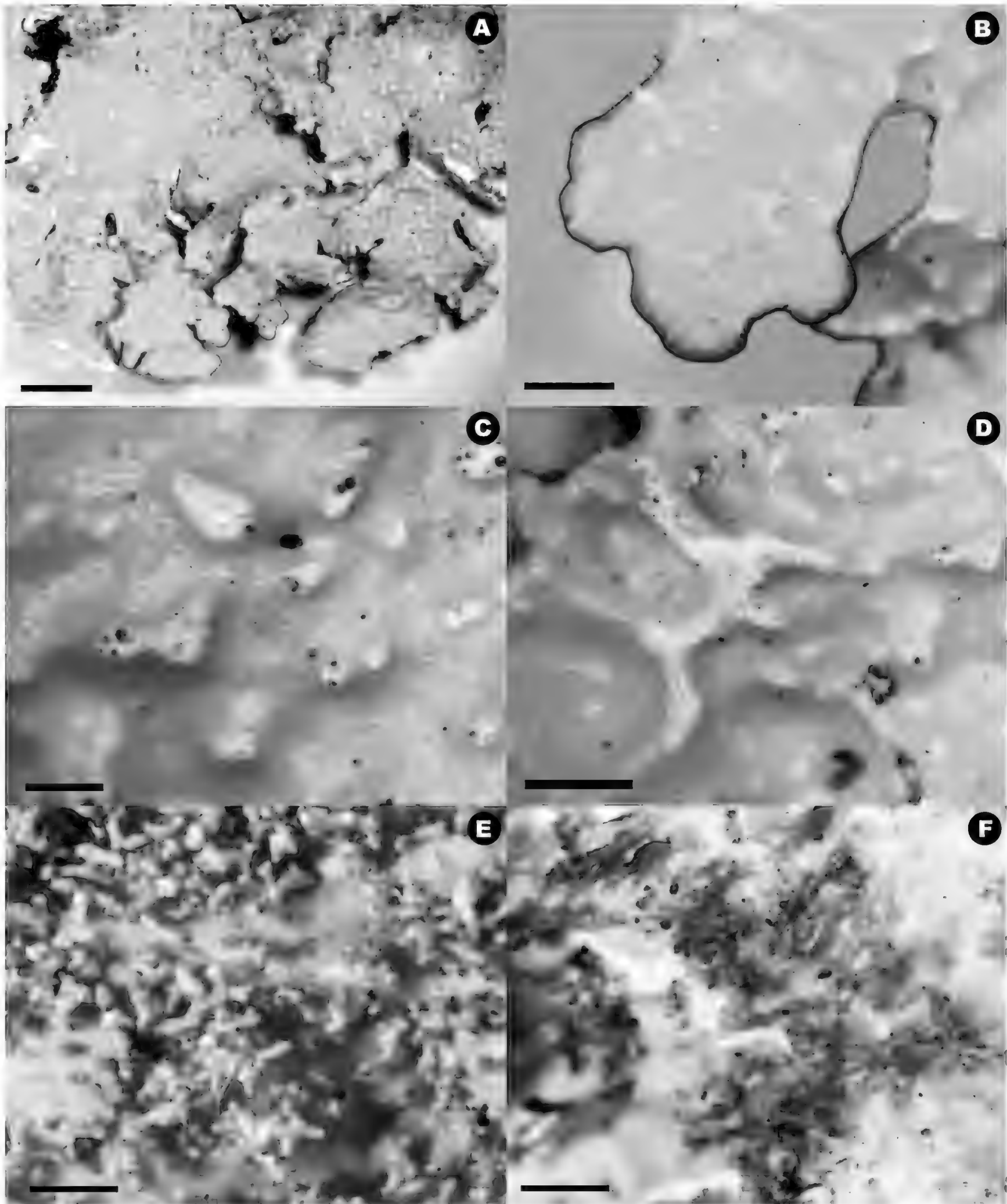


Figure 1. *Punctelia eganii* (all from holotype). A, macromorphology of the thallus (scale = 2.0 mm). B, detail of lobe tip (scale = 0.5 mm). C-D, pseudocyphellae (scale = 0.25 mm). E, isidia (scale = 0.5 mm). F, rhizines (scale = 0.5 mm).

DESCRIPTION – *Thallus* foliose, lobate, isidiate; lobes irregularly branched, 1.0-2.5 mm wide, adnate to loosely adnate (?), continuous to overlapping laterally, apices round, margins plane to somewhat upturned and often with a narrow brown band; upper surface continuous, glabrous, epruinose with some shallow poorly defined ridges, lacking scrobiculae; isidia abundant, corticate, simple and cylindrical to abundantly branched and coralloid, brown tipped, laminal and arising from both the pseudocyphellae and cracks in the thallus cortex; 0.2-0.5 mm tall; maculae absent; pseudocyphellae white, laminal, circular and punctiform, sometimes becoming sublinear, variable in size (~0.1-0.3 mm in diameter); medulla white, lacking pigments; lower surface pale brown to white, glabrous, smooth; rhizines sparse not forming a tomentum, concolorous with the underside or slightly darker brown, simple or occasionally branched, 0.3-0.8-(>1.0) mm in length; apothecia unknown; pycnidia unknown.

CHEMISTRY – Atranorin (? low concentration in the cortex and not detected with TLC; see Culberson and Culberson (1956)), lichexanthone (restricted to the pseudocyphellae); lecanoric acid (medulla).

Spot tests: cortex K-, C-, KC-, P-, UV-; pseudocyphellae K-, C+ red, KC+ red, P-, UV+ bright yellow; medulla, K-, C+ red, KC+ red, P-, UV-.

ETYMOLOGY – The species is named after Robert S. Egan, who collected the type specimen and brought its unusual chemistry to our attention.

ECOLOGY AND DISTRIBUTION – So far, only a single population has been discovered on bark in a beech-*Magnolia* forest in the coastal plain of southern Alabama. The natural landscape of the region in which the type locality is situated has been subjected to considerable anthropogenic change (Drummond & Loveland 2010). Remaining natural habitats largely exist as isolated fragments of variable size amid a dense mosaic of agriculture and urbanization. In light of the above, it is possible that *Punctelia eganii* was once more common but is now rare or even extirpated. It is equally probable that the species has been overlooked by collectors because of its morphological and chemical similarity to the ubiquitous *P. rudecta*. A search of all material from southeastern North America filed as *P. rudecta* at DUKE and NY failed to reveal any additional collections of *P. eganii*.

COMPARISON WITH OTHER SPECIES OF *PUNCTELIA* – *Punctelia eganii* is seemingly indistinguishable from *P. rudecta* based on morphology alone. Both species have a pale lower surface, lecanoric acid in the medulla, and abundant, corticate, cylindrical isidia. However, the striking fluorescence of the pseudocyphellae of *P. eganii* under UV light allows the two entities to be readily distinguished. Both *P. eganii* and *P. rudecta* may sometimes be confused with *P. missouriensis* G.Wilh. & Ladd or *P. punctilla* (Hale) Krog, but these species are readily distinguished by their diaspores. Both *P. missouriensis* and *P. punctilla* produce ecorticate, squamiform soredia, structures that can be misinterpreted as isidia (Wilhelm & Ladd 1987, Egan & Aptroot 2004, Lendemer & Hodkinson 2010).

DISCUSSION

As is noted above, the species described here represents the first reported occurrence of lichexanthone in the genus *Punctelia*. Although this substance is known from other parmelioid genera, particularly *Hypotrachyna* (Vainio) Hale (Hale 1975, Sipman et al. 2009) and *Parmotrema* A. Massal. (Spielmann 2009), its occurrence is not widespread in the family. Whereas species of *Hypotrachyna* produce lichexanthone in the cortex, species of *Parmotrema*, such as *P. ultraluscens* (Krog) Hale, produce this compound in the medulla. The occurrence of this compound in the medulla of *Punctelia eganii* indicates that this phenomenon may be more widespread in parmelioid lichens than previously recognized.

Some lichenologists may question the value of formally describing *Punctelia eganii* from a population that is effectively a chemical variant of the much more common *P. rudecta*. This criticism is reasonable in the absence of independent molecular sequence data. However, the inclusion of *P. eganii* in *P. rudecta* would require a significant expansion of the circumscription of the latter species. Specifically, it would require allowing for the existence of a chemotype that produces a secondary compound that is both otherwise unknown in the genus and is biosequentially distinct from the other compounds present in *P. rudecta*. With regard to taxonomic convention, broadening the circumscription of *P. rudecta* in this manner would significantly violate current species concepts in the parmelioid lichens as a whole, where differences in secondary chemistry are regarded as characters that warrant separation at the species rank. Although it

remains possible that *P. eganii* merely represents a chemotype of *P. rudecta*, we put forth the more probable hypothesis that it represents a distinct taxon that has previously been overlooked.

At present, the utility of chemical characters in circumscribing monophyletic parmelioid taxa at species rank remains largely untested by molecular methods. The few studies that have been produced provide conflicting results. For instance, Lendemer and Hodkinson (2010) found differences in secondary chemistry to be strongly correlated with other characters, making them useful in circumscribing species in *Punctelia* (i.e., *P. borrieri* (Sm.) Krog and *P. subrudecta* s.l.). Conversely, Leavitt et al. (2011) concluded that, although there were chemical trends in some species of *Xanthoparmelia* Hale, these did not correlate absolutely with clades reconstructed through analyses of molecular sequence data.

Studies of lichens outside of the family Parmeliaceae provide similarly conflicting results. Some studies have found examples where chemical characters correlate with molecular characters (Lendemer & Hodkinson 2009, Lücking et al. 2008), while others have documented cases where chemically distinct populations represent variants of a single taxon (Vondrák et al. 2010). Based on the differing outcomes encountered in studies of different taxa, it is almost certain that the utility of chemical characters in circumscribing monophyletic entities is variable and they cannot *a priori* be used or ignored. Indeed, the results obtained by Lendemer and Hodkinson (2009) best summarize the situation: in examining closely related species of *Cladonia*, we found that chemical characters sometimes correlated with other sets of characters, while at other times they did not. As such, we advocated a case-by-case approach in which the status of chemotypes is evaluated on an individual basis.

ACKNOWLEDGEMENTS

We thank Robert Egan for bringing the specimen described here to our attention and for granting permission to name the species in his honor. Thanks also to Jack Elix and Curtis Hansen for reviewing the manuscript.

LITERATURE CITED

- Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. New Haven & London: Yale University Press.
- Culberson, W.L. and C.F. Culberson. 1956. The systematics of the *Parmelia dubia* group in North America. American Journal of Botany, 43: 678-687.
- Culberson, C.F. and H. Kristinsson. 1970. A standardized method for the identification of lichen products. Journal of Chromatography, 46: 85-93.
- Drummond, M.A. and T.R. Loveland. 2010. Land-use pressure and a transition to forest-cover loss in the eastern United States. Bioscience, 60: 286-298.
- Egan, R.S. and A. Aptroot. 2004. *Punctelia*. In T.H. Nash III, B.D. Ryan, P. Diederich, C. Gries and F. Bungartz eds. Lichen Flora of the Greater Sonoran Desert Region, Vol. 2. Tempe, Arizona: Lichens Unlimited, Arizona State University. pp.431-436.
- Hale, M.E. Jr. 1975. A revision of the lichen genus *Hypotrachyna* (Parmeliaceae) in tropical America. Smithsonian Contrib. Bot., 25: 1-73.
- Krog, H. 1982. *Punctelia*, a new lichen genus in the Parmeliaceae. Nordic Journal of Botany, 2: 287-292.
- Leavitt, S.D., L. Johnson, and L.L. St. Clair. 2011. Species delimitation and evolution in morphologically and chemically diverse communities of the lichen-forming genus *Xanthoparmelia* (Parmeliaceae, Ascomycota) in western North America. Am. J. Bot., 98: 175-188.
- Lendemer, J.C., and B.P. Hodkinson. 2009. The wisdom of fools: new molecular and morphological insights into the North American apodetate species of *Cladonia*. Opuscula Philolichenum, 7: 79-100.
- Lendemer, J.C. and B.P. Hodkinson. 2010. A new perspective on *Punctelia subrudecta* in North America: previously-rejected morphological characters corroborate molecular phylogenetic evidence and provide insight into an old problem. The Lichenologist, 42: 405-421.
- Lücking, R., R. del Prado, H.T. Lumbsch, S. Will-Wolf, A. Aptroot, H.J.M. Sipman, L. Umana and J.L. Chaves. 2008. Phylogenetic patterns of morphological and chemical characters and reproductive mode in the *Heterodermia obscurata* group in Costa Rica. Systematics and Biodiversity, 6: 31-41.
- Sipman, H.J.M., J.A. Elix and T.H. Nash III. 2009. *Hypotrachyna* (Parmeliaceae, Lichenized Fungi). Flora Neotropica Monograph 104. The New York Botanical Garden Press, Bronx. 176 pp.
- Spielmann, A.A. 2009. Estudos taxonômicos em *Parmotrema* s.l. (Parmeliaceae, Ascomycota liquenizados) com ácido salazínico. Instituto de Botânica da Secretaria de Estado do Meio Ambiente, São Paulo. 152 pp.
- Vondrák J., J. Aoun, M. Sogaard, U. Söchting and U. Arup. 2010. *Caloplaca phlogina*, a lichen with two facies; an example of infraspecific variability resulting in the description of a redundant species. The Lichenologist, 42: 685-692.
- Wilhelm, G. and D. Ladd. 1987. *Punctelia perreticulata*, a distinct lichen species. Mycotaxon, 28: 249-250.

Calopadia schomerae (Pilocarpaceae), a New Lichen from Everglades National Park

FREDERICK C. SEAVEY¹ & JEAN L. SEAVEY²

ABSTRACT. – *Calopadia schomerae* is described from corticolous and foliicolous collections within Everglades National Park. Voucher specimens were obtained from two distinctly different habitats and substrates. Foliicolous collections were made within shaded hammock forests with high humidity while some of the corticolous specimens inhabited margins of dry roadbeds in brighter and considerably less humid conditions. The former exhibited lightly pruinose apothecia or pruina nearly absent while the latter are often distinctly pruinose. The new species is similar to *C. fusca* and *C. lucida* but differs in several characteristics.

INTRODUCTION

Worldwide, the genus *Calopadia* Vězda contains close to 25 species, these primarily occurring in the tropics and subtropics. Currently, thirteen published species are known from the Neotropics (Kalb & Vězda 1987, Lücking 2008). Several are typically foliicolous species but may also be found on bark, rock and other substrates; others are primarily non-foliicolous. Most contain no substances. However, two species, *C. lucida* Lücking & R. Sant. from Africa and *C. aurantiaca* Lücking, known only from the type collection in Brazil, contain xanthones. Within Everglades National Park several examples of both corticolous and foliicolous *Calopadia* have been collected which fluoresce dull to bright orange in ultraviolet light. All collections share the same chemistry, spore size and general internal and external morphological characteristics, and are herein described as the new species *Calopadia schomerae*.

MATERIALS AND METHODS

Collections are from Everglades National Park and were examined using standard stereoscopic and light microscope techniques. Images were taken with a Leica DFC295 camera mounted on a DM750 Leica trinocular microscope and captured with Leica Application Suite V3.6.0 software. Photos were taken at the automatic setting and undoubtedly enhanced to some degree by the program. No additional enhancement was done unless noted. Chemical analysis was accomplished by thin layer chromatography (TLC) in systems C and E following the procedures outlined in Orange et al. (2001).

THE NEW SPECIES

Calopadia schomerae F. Seavey & J. Seavey sp. nov.

Mycobank #561206.

FIGURE 2 (PAGE 41).

Thallus crustaceus, griseo-viridis, in luce ultravioleacea fluorescens. Apothecia pruinosa.
Hypotheций pallido-fuscescens.

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Figure 1. Holotype collection site north of Ficus Pond, Everglades National Park.

TYPE: U.S.A. FLORIDA. MIAMI-DADE CO.: Everglades National Park, 250 meters N of Ficus Pond trail, 025° 22'N, 080° 49'W, elevation 1 m., corticolous on *Annoma glabra*, 10.iii.2009, *F. Seavey & J. Seavey 12961E* (FNPS, holotype).

DESCRIPTION. – **Thallus:** Grayish-green to greenish-gray, epiphloeodal (also epiphyllous), 55-75 µm thick, continuous, smooth to verruculose, round to elongate, often with discontinuous white prothallus. **Cortex:** 5-10 µm thick of small paraplectenchymatous cells (generally absent in foliicolous specimens). **Photobiont:** chlorococcoid algae, cells roundish, 0.4-0.6 µm diam. **Apothecia:** Round, sessile, constricted at the base; disc orangish-brown to brown, 0.5-0.75 mm wide, plane to slightly convex, white pruinose especially when young and exposed; margin thin, persistent, pale brown, paler than the disc. **Excipulum:** colorless, paraplectenchymatous, 30-50 µm thick. **Hypothecium:** Pale brown, 50-60 µm tall. **Epithecium:** Thin, indeterminate. **Hymenium:** 80-90 µm tall, hyaline. **Asci:** 75-85 x 22-24 µm, single spored. **Ascospores:** 55-75 x 20-22 µm, hyaline, muriform, narrowly elliptical. **Campylidia:** Sessile, 0.3-0.5 mm at the black to gray base, hood paler gray expanding to 0.65-0.85 mm, upper convex surface often white pruinose, socle absent, conidiogenous layer K+ blue. **Conidia:** Filiform, arcuate often extremely so, multiseptate, 25-31 x 3 µm.

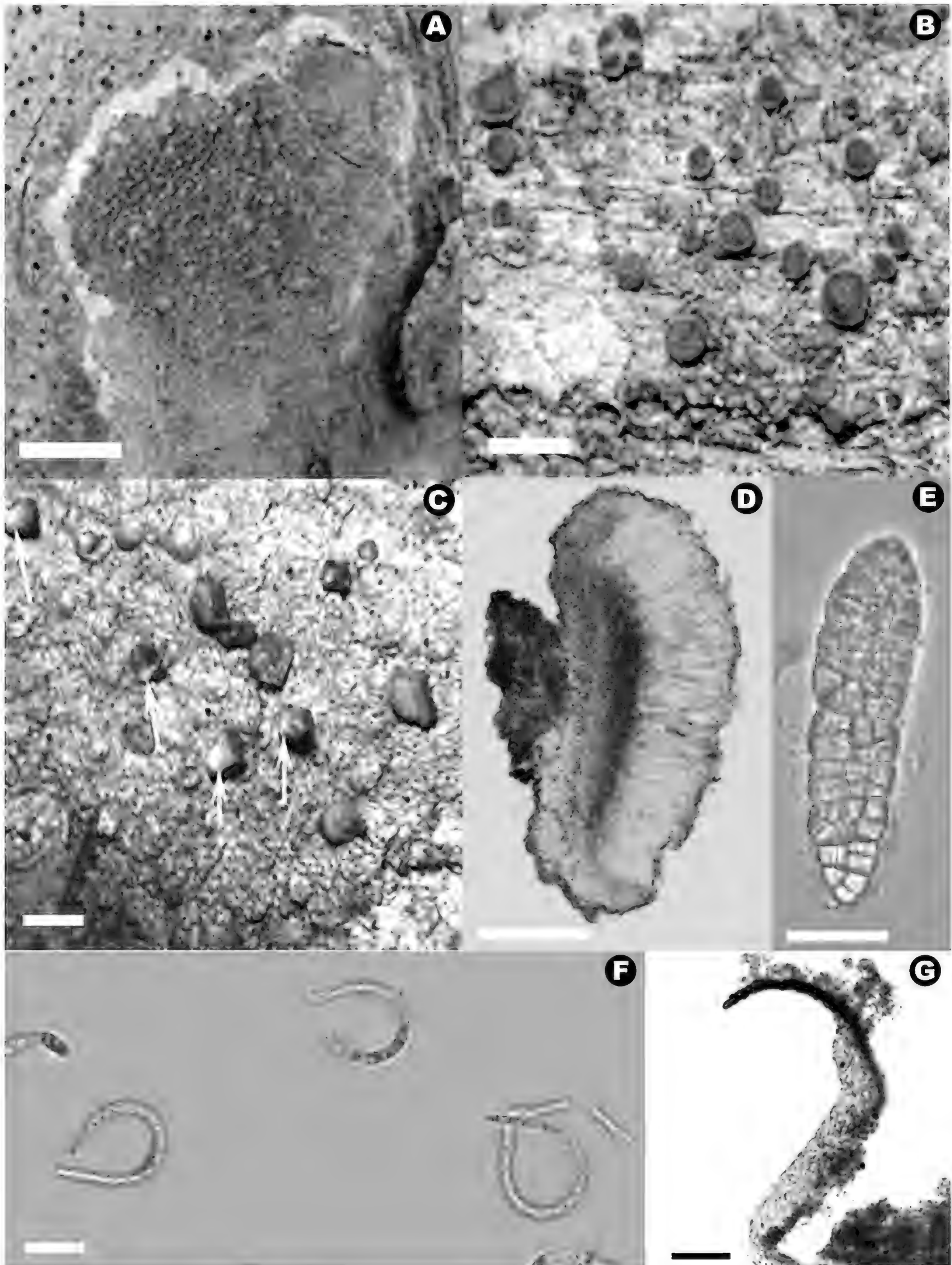


Figure 2. **A**, *Calopadia schomerae* in situ with scattered campylidia after rain. **B**, thallus and apothecia, dry thallus. **C**, campylidia (arrows point out pruinose patches on the non-conidiogenous surface). **D**, thin section showing pale brown of hypothecium. **E**, muriform spore. **F**, arcuate multiseptate conidia. **G**, conidiogenous layer of the campylidia treated with 10% aqueous solution of KOH. Scales = A: 1 cm, B & C: 1 mm, D: 100 μ m, E-G: 20 μ m.

ETYMOLOGY. – The new species is dedicated to our close friend and colleague Barbara Schomer, an intrepid cave explorer, traveler and educator, for her many unselfish contributions to the study of the natural world including lichenology.

CHEMISTRY. – Two xanthones were detected: Unknown 1. Rf C 47-49 E 15-17 UV orange-red before char; visibly colorless and UV green after char. Unknown 2. Rf C 72-74 E 39-41 UV dull red before char; visibly colorless and UV green after char. Unknown 1 conforms to 2,4,5-Trichloro-3-O-methylnorlichexanthone (thuringione) but HPLC should be conducted before formally declaring it as such. All spot tests negative. UV+ dull to bright orange.

ECOLOGY AND DISTRIBUTION. – *Calopadia schomerae* has been found among a variety of communities from the Northeast section of the Park. Corticolous examples are most common and well developed within pond apple (*Annona glabra*) swamps but have also been found along a dry abandoned roadbed. Foliicolous collections have so far been restricted to hammock interiors.

DISCUSSION. – Many of the collections were made along an abandoned roadbed with a single row of small trees bordering it in moderately bright sunlight. The apothecia from this habitat have distinctly pruinose discs especially in the young stage. Conversely, the apothecia of foliicolous collections from humid shady hammocks normally possess only a light scattering of pruina across its surface or on the margin. The site of the holotype collection (Fig. 1) shared the humidity of the latter but was considerably more open. Apothecia from this site were also pruinose (Fig. 2b). Foliicolous collections are also ecorticate with apothecia averaging 0.3-0.5 mm in diameter and correspondingly slightly smaller measurements for internal components. However, the chemistry of both corticolous and foliicolous collections is identical and ascospore size variation is not significantly different. In our opinion, the differences are not distinct enough to consider them anything but conspecific.

Calopadia schomerae is superficially similar to several members within the genus but its combination of gray-green thallus, pale brown hypothecium, pruinose apothecia and a UV reactive thallus separate it from all other species. *Calopadia lucida*, a foliicolous species from Africa, is similar but has a different chemistry and dissimilar conidiospores (Lücking & Santesson 2001). *Calopadia floridana* Hodges & Lücking and *C. imshaugii* Common & Lücking, both recently described from nearby Collier County, Florida, contain no substances, have dissimilar conidiospores and the latter has bi-spored asci (Lücking et al). *Calopadia aurantiaca*, from Venezuela, contains an unknown xanthone but has an orange-yellow thallus which reacts K+ wine-red. Conidiospores were not available for study in that species (Lücking 2008).

We believe foliicolous examples from shady hammocks of *C. schomeri* are fairly common and have been overlooked or misidentified. Apothecia discs from this habitat appear only slightly pruinose in the field and can be confused with *C. fusca* (Müll Arg.) Vězda. This may be due to the high humidity of that habitat making the pruina more translucent (and thus overlooked) than corticolous collections from innately drier habitats (Lücking per. comm).

ADDITIONAL SPECIMENS EXAMINED. – **U.S.A. FLORIDA.** MIAMI-DADE CO.: Everglades National Park, interior Mahogany Hammock, 7.ii.2010, on leaf of *Eugenia axilaris*, F. Seavey & J. Seavey 906MH (FNPS); Everglades National Park, cypress dome west of Ficus Pond, 10.iii.2009, on bark of *Taxodium distichum*, F. Seavey & J. Seavey 12753E (FNPS); Everglades National Park, abandoned section of Old Ingraham Highway, 14.xi.2010, on bark of *Metopium toxiferum*, F. Seavey & J. Seavey 2377IH (FNPS); Everglades National Park, near Coe campsite, 28.xi.2010, on bark of *M. toxiferum*, F. Seavey & J. Seavey 12537E (FNPS); Everglades National Park, near end of mitigation ponds along Old Ingraham Highway, 29.xi.2010, on bark of *M. toxiferum*, F. Seavey & J. Seavey, 4130IH (FNPS); Everglades National Park, Lott hammock, 15.i.2011, on *Sideroxylon salicifolia*, F. Seavey & J. Seavey, 14208E (FNPS); Everglades National Park, east Everglades acquisition area, 17.ii.2011, on bark of *Schinus terebinthefolius*, F. Seavey & J. Seavey, 4759CR (FNPS).

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LITERATURE CITED AND REFERENCES USED

- Kalb, K. and A. Vězda. 1987. Einige nicht-foliicole Arten der Familie *Ectolechiaceae* (Lichenes) aus Brasilien. *Folia Geobotanica et Phytotaxonomica*, 22: 287- 312.
- Lücking, R. 1999. Líquenes folícolas de la Estación Biológica La Selva, Costa Rica: Inventario, comunidades y comparación florística de tipos de vegetación. *Revista de Biología Tropical*, 47(3): 765-772.
- Lücking, R. 2008. Foliicolous lichenized fungi. *Flora Neotropica Monograph*, 103: 1-866.
- Lücking R. and R. Santesson. 2001. New species or interesting records of foliicolous lichens. VIII. Two new taxa from tropical Africa, with a key to sorediate *Fellhanera* species. *The Lichenologist*, 33(2): 111-116.
- Lücking, Robert, Frederick Seavey, Ralph Common, Sean Q. Beeching, Othmar Breuss, William R. Buck, Lee Crane, Malcolm Hodges, Brendan P. Hodkinson, Elisabeth Lay, James C. Lendemer, Troy McMullin, Joel A. Mercado-Díaz, Matthew P. Nelsen, Eimy Rivas Plata, William Safranek, William B. Sanders, Harold P. Schaefer Jr. and Jean Seavey 2011. The lichens of Fakahatchee Strand Preserve State Park, Florida: Proceedings from the 18th Tuckerman Workshop. *Bulletin of the Florida Museum of Natural History*. 49(4): 127-186.
- Orange, A., P.W. James, and F.J. White. 2001. Microchemical methods for the identification of lichens. *British Lichen Society*. 101pp.
- Sérusiaux, E. 1979. Foliicolous lichens from southeastern United States. *The Bryologist*, 82: 88–93.

Studies in lichens and lichenicolous fungi – no 15: miscellaneous notes on species from eastern North America

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ABSTRACT. – *Acarospora americana* is revised and separated from *A. veronensis*. *Acarospora superfusa* and *A. cinereoalba* are placed in synonymy with *A. americana*. A lectotype is selected for *A. cinereoalba*. A key to the *Acarospora* species from North America with gyrophoric/lecanoric acid is presented. *Acarospora gallica*, *A. rugulosa*, *A. sparsa*, *A. tongleti*, and *A. variegata* are excluded from the North American lichen biota. Range extensions are reported for *A. janae*, *A. nicolai*, and *Sarcogyne reebiae*. The name *Arthonia subcyrtodes* is placed in synonymy with *A. intervienens*. The combination *Bactrospora carolinensis* (for *Patellaria carolinensis*) is proposed and *B. mesospora* is placed in synonymy. The following taxa are described as new to science: *Acarospora piedmontensis* (from the Piedmont of southeastern North America), *A. sphaerosperma* (from the Ozarks and Ohio), *Lecanora zeroensis* (from the Coastal Plain of Georgia), and *Melanophloea americana* (from the Mid-Atlantic Region). *Polysporina cyclocarpa* is newly reported from continental North America. *Xanthomendoza weberi* is revised to include *X. rosmarieae* and *Xanthoria wetmorei* as synonyms.

KEYWORDS. – Calciphiles, keys, new species, taxonomy.

INTRODUCTION

It is widely recognized that fieldwork and revision of herbarium specimens yields new discoveries, interesting finds, and occasionally clarifies or solves long standing taxonomic/nomenclatural or floristic problems. Often, this research is peripheral to other projects and although such information should be disseminated in print it does not always fit well in the context of other project-specific publications. As such we began this series in 2004 with the intent of establishing a vehicle to communicate short relevant notes on lichens and lichenicolous fungi. For various reasons the title of this series has evolved since 2004, and although most numbers were published in *Mycotaxon* some were published elsewhere. In an effort to standardize numbering of this series and facilitate its citation by researchers we provide an index below following the materials and methods section. The present contribution continues this series with a compilation of notes on taxa from eastern North America, many of which pertain to research conducted by the first author in collaboration with the other authors during a month long visit to The New York Botanical Garden (NYBG) in March, 2011.

MATERIALS AND METHODS

Specimens were studied in dry condition using a Bausch & Lomb StereoZoom 7 dissecting microscope and subjected to chemical analysis using standard spot tests (reagents are abbreviated following Brodo et al. (2001)) and Thin Layer Chromatography (TLC). TLC was carried out at NY using solvents A and C, following Culberson & Kristinsson (1970). Images were captured using an Olympus DP20 digital camera with Microsuite Special Edition. The illustrations were prepared using Adobe Photoshop. All measurements are based on water mounts of hand cut sections unless otherwise indicated.

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PART I – INDEX TO THE SERIES “*STUDIES IN LICHENS AND LICHENICOLOUS FUNGI*”

- No. 1) Lendemer, J.C. 2004. Changes and additions to the checklist of North American lichens. – I. Mycotaxon, 89(2): 255-258.
- No. 2) Lendemer, J.C. and Yahr, R. 2004. Changes and additions to the checklist of North American lichens. II. Mycotaxon, 90(2): 319-322.
- No. 3) Knudsen, K. and J.C. Lendemer. 2005. Changes and additions to the checklist of North American lichens. III. Mycotaxon, 93: 277-281.
- No. 4) Knudsen, K. and J.C. Lendemer. 2005. Changes and additions to the North American lichen flora. IV. Mycotaxon, 93: 289-295.
- No. 5) Knudsen, K. and J.C. Lendemer. 2006. Changes and additions to the North American Lichen Flora. – V. Mycotaxon, 95: 309-313.
- No. 6) Lendemer, J.C. and K. Knudsen. 2007. Changes and additions to the North American lichen mycota. – VI. Proceedings of the Academy of Natural Sciences of Philadelphia, 156(1): 55-57.
- No. 7) Knudsen, K. and J.C. Lendemer. 2007. Studies in lichens and lichenicolous fungi: notes on some North American taxa. Mycotaxon, 101: 81-88.
- No. 8) Lendemer, J.C. and K. Knudsen. 2008. Studies in lichens and lichenicolous fungi: further notes on North American taxa. Mycotaxon, 103: 75-86.
- No. 9) Lendemer, J.C. 2008. Studies in lichens and lichenicolous fungi: notes on some taxa from eastern North America. Mycotaxon, 104: 325-329.
- No. 10) Lendemer, J.C., J. Kocourková, and K. Knudsen. 2008. Studies in lichens and lichenicolous fungi: notes on some taxa from North America. Mycotaxon, 105: 379-386.
- No. 11) Lendemer, J.C., J. Kocourková, and K. Knudsen. 2009. Studies in lichens and lichenicolous fungi: more notes on taxa from North America. Mycotaxon, 108: 491-497.
- No. 12) Lendemer, J.C., J. Kocourková, and K. Knudsen. 2009. Studies in lichens and lichenicolous fungi: more notes on taxa from North America. Mycotaxon, 110: 373-378.
- No. 13) Kocourková, J., A.M. Fryday, K. Knudsen and J.C. Lendemer 2010. Studies in lichens and lichenicolous fungi: more notes on taxa from North America 6. Mycotaxon, 111: 423-429.
- No. 14) Lendemer, J.C. and K. Knudsen. in press. Studies in lichens and lichenicolous fungi: 7, more notes on taxa from North America. Mycotaxon, 115.

PART II - NOTES

- 1) *Acarospora americana* H. Magn., Kungl.-Akad. Handlingar, 7(4): 198. 1929. TYPE: U.S.A. ILLINOIS. KANE CO.: sine loc., 1895, on silicate rock, *B. Fink s.n.* (UPS!, holotype; MIN! NY! isotypes).

Syn nov. *Acarospora cinereoalba* Fink ex H. Magn., Kungl.-Akad. Handlingar, 7(4): 205. 1929. TYPE: U.S.A. ILLINOIS. KANE CO.: sine loc., vii.1895, on silicate rock, *B. Fink s.n.* (NY!, lectotype designated here)

Lecanora cervina v. *cinereoalba* Fink nom. nud., Minn. Bot Studies, 2: 319. 1899.

Acarospora cervina v. *cinereoalba* (Fink) Fink comb. inval., Mycologia, 1: 88. 1909

Syn. nov. *Acarospora superfusa* H. Magn., Meddel. Göteborgs Bot. Trädgård, 5: 65. 1930. TYPE: U.S.A. NEW MEXICO. SAN MIGUEL CO.: Las Vegas, 2000 m., 1927, on sandstone, A. Brouard (hb. Bouly de Lesdain [n.v], holotype presumed destroyed; UPS!, isotype).

FIGURES 1-3 (PAGES 48-50).

DESCRIPTION. – *Hypothallus* endosubstratic. *Thallus* of dispersed or contiguous areoles to subsquamules, these often lobulate, up to 3 mm in diameter, to 0.6 mm high, but often shorter, rarely forming squamules; occasionally forming verrucae (then sometimes looking similar to *A. elevata* H. Magn. especially if surface is shiny). *Attachment* broad, the mycelial base sometimes elongating, rarely forming a stout, stipe-like structure. *Upper surface* pale to dark brown, sometimes black, epruinose, matt or rarely

shiny, usually smooth, or often densely pruinose especially in arid habitats of western North America, sometimes with a blackish margin. *Lower surface* white to dark brown, ecorticate, becoming black through interaction with substrate. *Cortex* paraplectenchymatous, mostly 20-40 μm thick, with thin upper layer reddish brown, lower layer hyaline, rarely with an epinecral layer of dead and gelatinized hyphae, <10 μm thick. Cortical cells distinct, round, 3-6 μm in diam. *Algal layer* continuous, not interrupted by hyphal bundles, relatively even, mostly 100-140 μm thick, thinner to lacking beneath apothecium, algal cells mostly 10-15 μm in diam. *Medulla* hyaline, mostly of thin-walled hyphae, 2-4 μm , with some hyphae to 6 μm , often swollen at septa, branching, continuous with attaching hyphae, often interspersed with crystals to 15 μm in diam., most dissolving in K. *Apothecia* 1-6 per areole, often with a single apothecium. *Disc* immersed, dull brown to black, usually epruinose, red-brown when wetted, usually round, smooth, up to 1 mm in diam., but sometimes punctiform and <0.3 mm, especially in eastern North American specimens the disc surrounded by a distinctive elevated parathecial crown rising above the surface of the disc but visible in infrequent immature areoles in many specimens. Parathecium narrow to expanded to 80 μm wide in crown. *Hymenium* hyaline, spreading in water, mostly (80-)100-120(-150) μm tall, epihymenium c. 10 μm tall, coherent in water, pigmentation light brown, paraphyses mostly 2 μm in diam., apices usually slightly expanded to 3 μm , often with brown pigment caps, I+ blue, usually slowly turning red. Asci various, cylindrical to clavate, 60-110 x 12-25 μm . *Ascospores* simple, hyaline, narrow to broadly ellipsoid, mostly 4-5 x 2 μm , 100-200 per ascus. *Subhymenium* 35-40 μm thick, hyaline or golden. *Hypothecium* distinct, of thin hyphae, 10-15(-30) μm deep, hyaline, variable. Pycnidia not observed.

CHEMISTRY. – No substances detected. Spot tests: K-, C-, KC-, P-, UV-.

ECOLOGY AND SUBSTRATE. – *Acarospora americana* is common on granitic rock, volcanic rock and sandstone, rarely occurring on calcareous rock, cinnabar, mine tailings, soil or wood, in a wide range of habitats.

DISTRIBUTION. – The species is widespread in North America.

DISCUSSION. – It is with great pleasure that we are able to resurrect the absolutely appropriate name *Acarospora americana* for one of the most common species in North America outside of the Greater Sonoran Desert Region. In the *Sonoran Flora*, a broad concept of *A. veronensis* A. Massal. was used when the first author was unable to resolve the delimitation of *A. americana*, *A. cinereoalba*, and *A. superfusa* from *A. veronensis* s. str. within that study area (Knudsen 2007). In 2011, examination of the extensive holdings at NY from eastern and midwestern North America provided a panoramic view of the variation in this common species and the opportunity to solve this perplexing problem, bringing to conclusion the process that began with the separation of *A. superfusa* from *A. veronensis* (Lendemer & Knudsen 2011).

Acarospora americana was originally described by Magnusson (1929) from epruinose brown areoles in the type collection of *A. cinereoalba* collected by Bruce Fink in Kane County, Illinois in 1895. Fink himself determined these epruinose brown areoles incorrectly, but consistently, as *L. cervina* Ach. Admixed with these areoles on the same specimen there were also pruinose areoles which Fink correctly recognized as a pruinose variation of *L. cervina*. He published the name *L. cervina* v. *cinereoalba* for such pruinose areoles; however the protologue does not contain a differential diagnosis and thus the name is a *nomen nudum*. Subsequently, Magnusson (1929) validated the name *A. cinereoalba*, describing the pruinose individuals as *A. cinereoalba* while describing the epruinose individuals as *A. americana*. There are no differences in macro- or micromorphology between *A. americana* and *A. cinereoalba* except the presence/absence of pruina, which is a variable character even in the type material (fig. 1B, D & F). Magnusson (1929) even had misgiving about *A. cinereoalba* stating “more on account of its appearance rather than its anatomy I have got the opinion that it is a separate species.”

We recently removed *Acarospora superfusa* from synonymy with *A. veronensis* based on its areoles that are larger when fully developed and can become squamulose (Lendemer & Knudsen 2011). *Acarospora superfusa* is recognized here as another name for the pruinose form of *A. americana* (figs. 1-3). Magnusson (1929) considered *A. superfusa* to have a wider disc and larger more heavily pruinose areoles than his concept of *A. cinereoalba*. As was the case for *A. cinereoalba*, Magnusson's species concept was based on gestalt rather than his usual taxonomic measurements (Magnusson 1930; Lendemer & Knudsen 2011).

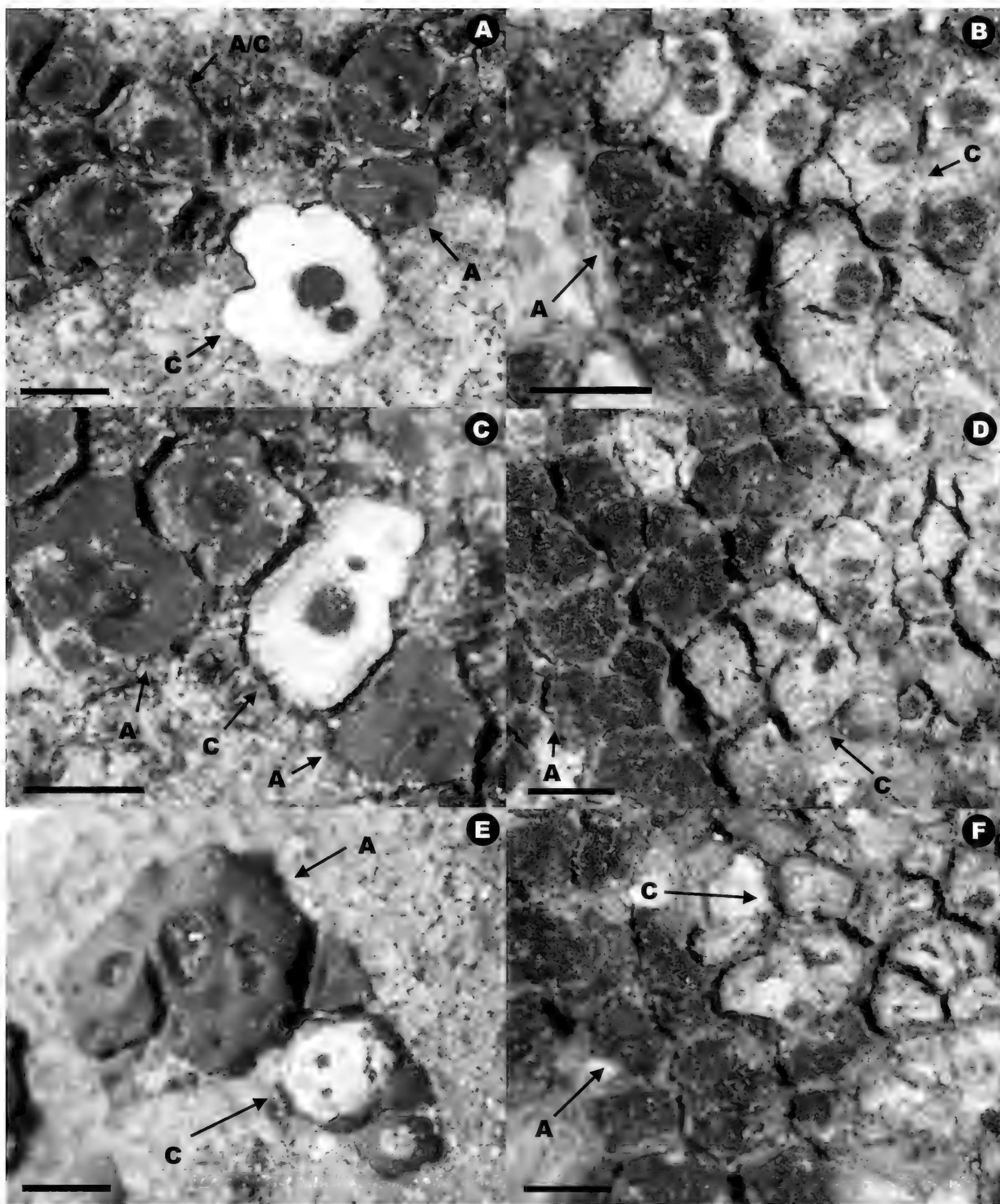


Figure 1, *Acarospora americana*, areoles marked “A” were described or would be determined by Magnusson as *A. americana* while those marked “C” were described or would be determined by Magnusson as *A. cinereoalba*. **A, C & E**, variation of pruinose and epruinose areoles in a single population (*Harris 12143*; scales = 0.5 mm). **B, D & F**, isotype of *A. americana* and lectotype of *A. cinereoalba* (*B. Fink s.n.*; scales = 0.5 mm).

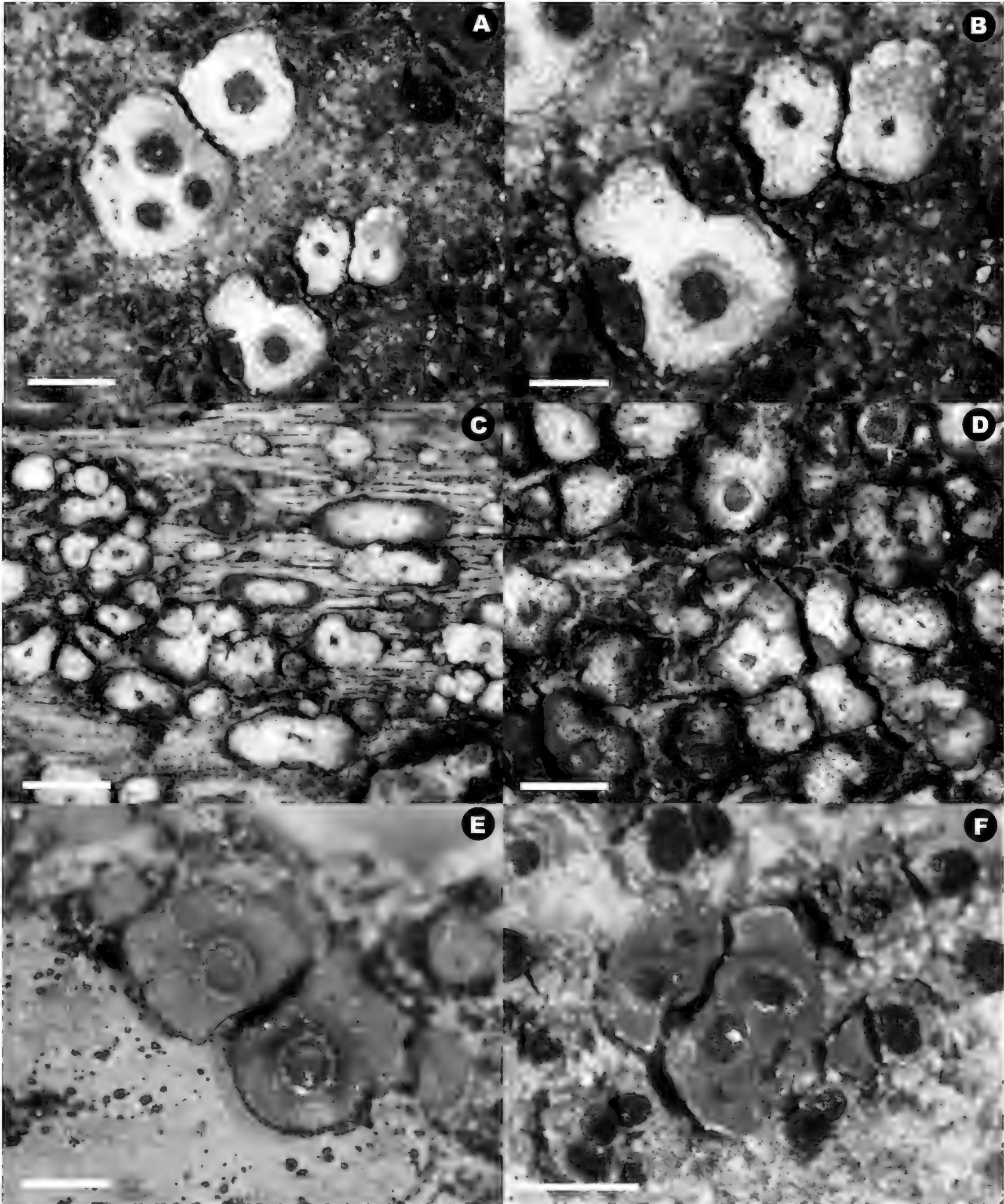


Figure 2, *Acarospora americana*. A & B, typical pruinose specimens Magnusson would determine as *A. superfusa* (Harris 12143; scales = 0.5 mm). C & D, *A. americana* growing on wood (Advaita 6122; scales = 0.5 mm). E & F, typical epruinose population with elevated parathecial crowns and lobulate areoles (Buck 36470 & Harris 12143 respectively; scales = 0.5 mm)

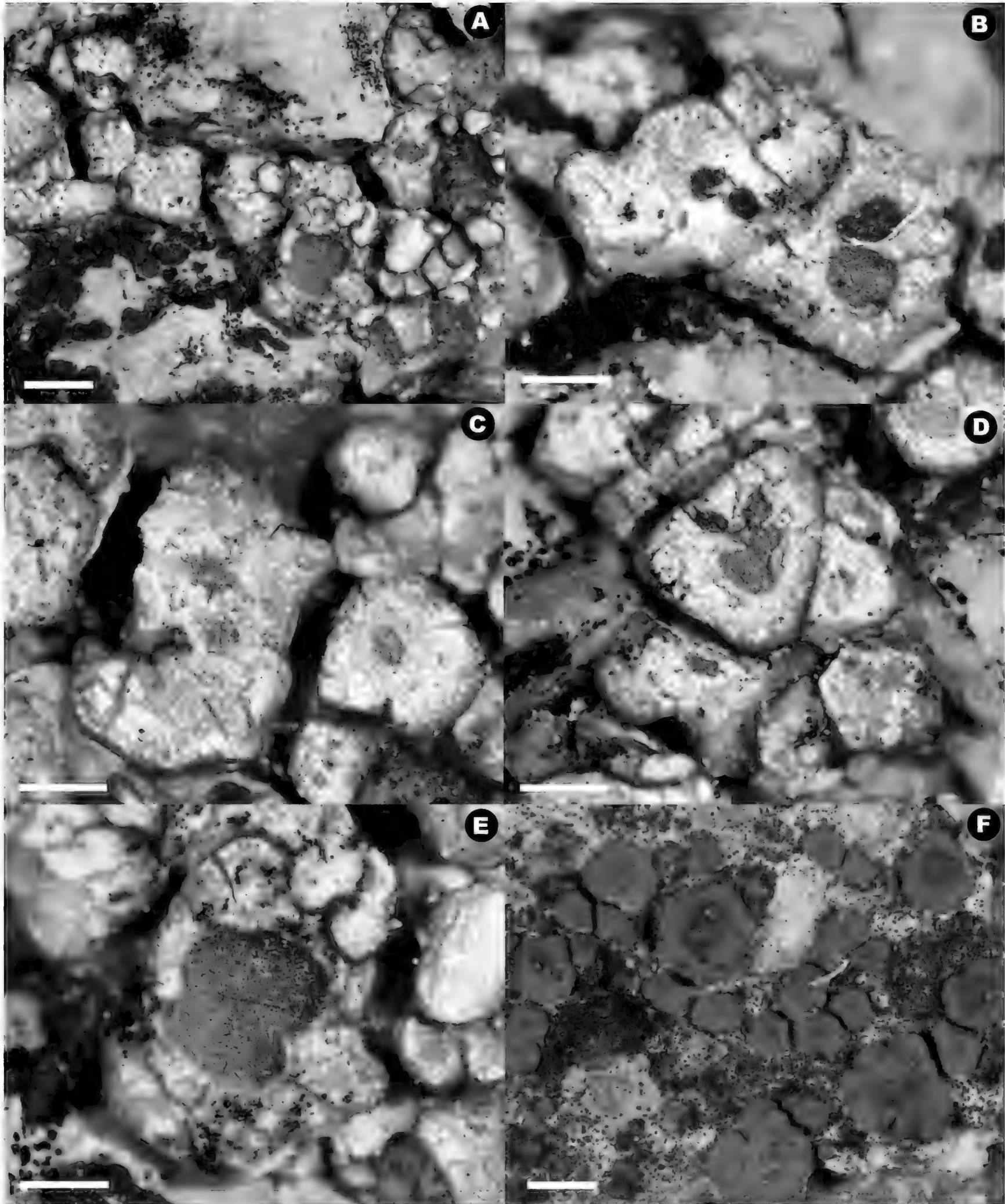


Figure 3, *Acarospora americana*. A-E, typical large pruinose population of *A. americana* Magnusson would have identified as *Acarospora superfusa* (Morse 15048). F, typical epruinose population with elevated parathecial crowns (Buck 36470). Scales = A & F: 1.0 mm; B-E: 0.5 mm.

We compared Magnusson's description of *Acarospora veronensis* (Magnusson 1929), European specimens of that taxon, and the revised description of *A. americana*. On the macromorphological level, *A. veronensis* differs from *A. americana* in having areoles that are generally smaller (usually 0.3-0.5(-1.0) vs. usually 0.5-2.5 mm), lacking subsquamulose lobulation, parathecial crowns, and pruina. On the micromorphological level, *A. veronensis* differs from *A. americana* in having a thin (to 15 μm) or indistinct parathecium (thus not forming an expanded parathecial crown), a generally lower hymenium ((65-80 vs. (90-)100-120(-150) μm)), and a shorter subhymenium (usually 15-20 vs. 30-40 μm). There are no substantial differences in ascus and ascospore size between the two species. Both species predominately have one apothecium per areole (fig. 1E). Reduced specimens of *A. americana* often are macroscopically indistinguishable from *A. veronensis* in America. The easiest way to separate *A. veronensis* from such reduced forms of *A. americana* is by its hymenium which is approximately 80 μm high. The two species are sympatric in southern California and the Ozarks (regions not glaciated during the last ice age), with *A. americana* being the common species and *A. veronensis* the infrequent species. In Europe, *A. veronensis* is common. It is not known if *A. americana* occurs in Europe.

Specimens and populations of *Acarospora americana* can differ in their gestalt through environmental interactions. The species can be considered polymorphic as is expected in a successful species with a wide distribution including many different habitats and a variety of substrates, including wood and mercury mine tailings. It is also likely a nitrophile and can probably become quite large in size and even squamulose in enriched microhabitats. One must become familiar with the prevalent phenotype in one's study area. This can only be done with careful micromorphological study, but fortunately these characters are relatively invariable. The majority of specimens had a hymenial height of 100 μm , though occasionally they are as tall as 150 μm . One common form of *Acarospora americana* has elevated parathecial crowns with a single apothecium per areole (fig. 1E). It is infrequent throughout most of its range, but common in Quebec and Ontario in Canada and the Piedmont of South Carolina. The occurrence of this form is noted in specimens cited.

The majority of the specimens of *Acarospora americana* we examined were epruinose. Epruinose populations are rather plain and easily overlooked when reduced. When densely pruinose, the species can be confused with some specimens of *A. nicolai* (Knudsen & Morse 2009). That species is distinguished especially by the presence of gyrophoric/lecanoric acids (note these are sometimes only detectable by TLC). It has overlapping measurements with *A. americana* and is sympatric at least in the Great Plains and the Ozarks.

The variability of *Acarospora americana* caused Magnusson to describe the species again as *A. applanata* H. Magn. This name will be treated in a future publication because a lectotype needs to be selected, but it is definitely a synonym, based on several types examined from New Mexico at FH and UPS. Magnusson misidentified Californian material of *A. americana* collected by A.C.T.W Herre (FH!) as *A. obscura* H. Magn., a species we only recognize as occurring in Africa if it is a distinct species at all (Magnusson 1929, Knudsen 2007). It should be noted that *A. tenebrica* H. Magn. described from Texas is still considered a synonym of *A. veronensis* (Magnusson 1929, Knudsen 2007).

Selected specimens of Acarospora americana examined. – **CANADA. ONTARIO.** BRUCE CO.: Bruce Peninsula National Park, 190 m, 21.ix.2008, *W.R. Buck* 54247 (NY). CARLETON CO.: Ottawa, along Rideau River, Hog's Back, 8.x.1976, on granite, *R.C. Harris* 12143 (NY, elevated parathecial crowns abundant). **SASKATCHEWAN.** Grasslands National Park, 899 m, 19.vi.2009, on acid rock, *C. Freebury* 859 (CANB). **QUEBEC.** Comté de Charlevoix-Est, Centre Ecologique de Port-au-Saumon, along St. Lawrence River, 9.xii.1997, on granitic shoreline rocks, *W.R. Buck* 32405 (NY, elevated parathecial crowns common). **U.S.A. CALIFORNIA.** [COUNTY UNKNOWN]: sine date, *H.N. Bolander* 136 (NY); LOS ANGELES CO.: Santa Monica Mountains, 1905, *H.E. Hasse s.n.* (NY); Latigo Canyon, 571 m, 15.ix.2004, *K. Knudsen* 1538 (UCR); Claremont, Bernard Biological Field Station, 420 m, 17.i.2005, on granite boulder, *K. Knudsen et al.* 2183.2 (UCR). ORANGE CO.: Santa Ana Mountains, upper Fremont Canyon, 596 m, 16.vii.2005, on sandstone, *K. Knudsen et al.* 3417 (UCR); Santa Rosa Plateau, 573 m, 13.vi.2006, on scattered volcanic rocks on clay, *Knudsen* 6400 (UCR). RIVERSIDE CO.: Joshua Tree National Park, Lost Horse Mountain, 1539 m, 9.xii.2010, on gneiss, *K. Knudsen* 12915.3 (UCR); Palm Springs, sine date, *H.E. Hasse s.n.* (NY); 1900, *H.E. Hasse* (NY). SAN BENITO CO.: Clear Creek Management Area (BLM), cinnabar outcrop above Clear Creek Road, 1000 m, 21.iv.2011, common on cinnabar, *Knudsen et al.* 13589 (NY, UCR, most thallus surfaces black in overall populations); New Idria, 777 m, 22.iv.2011, common on mercury mine tailings and sandstone in full sun near historic mill, *K. Knudsen et al.* 13608 (UCR). SAN BERNARDINO CO.: Joshua Tree National Park, Eureka Peak, 1591 m, 22.ii.2006, *K. Knudsen* 5252.2 (UCR); Clark Mountains, Mojave National Preserve, edge of wash south of Pachalka Springs, 1548 m, 11.x.2009, on HCl- boulder, *K. Knudsen* 11769 w/ *N. Pietrasiak* (UCR). SAN DIEGO CO.: Santa Margarita Mountains, near Margarita Peak, Camp Pendleton, 778 m,

24.x.2005, on granite boulder in sun, *K. Knudsen et al.* 4222 (UCR). SANTA BARBARA CO.: Santa Rosa Island, near east end of Navy Road, 72 m, 14.x.2006, on sandstone, *K. Knudsen* 7411 w/ *S. Baguskus* (UCR). VENTURA CO.: Santa Monica Mountains, Point Magu State Park, Sycamore Canyon, 182 m, 2.vi.2009, on small half-buried volcanic stones, *K. Knudsen* 11218 w/ *T. Sagar* (UCR). **IOWA.** FAYETTE CO.: 1896, *B. Fink s.n.* (NY; elevated parathecial crowns infrequent); same county, vii.1896, *B. Fink s.n.* (NY). **KANSAS.** ELLSWORTH CO.: Kanopolis State Park, Horsethief Canyon, 1000 m, 27.iv.2006, *C.A. Morse* 12733.1 w/ *C.C. Freeman* (KANU, UCR). **MAINE.** WASHINGTON CO.: Douglas Island Harbor, 2 m, 26.iix.2001, *D. Flenniken* 7304 (UCR). **MISSOURI.** WASHINGTON CO.: Hughes Mountain Conservation Area, 3.xi.2002, on rhyolite, *A. Amtoft* 320 (NY). **MONTANA.** [COUNTY UNKNOWN]: Two-Medicine Lake, Blackfeet Indian Reservation, xii.1897, on granite, *R.A. Williams s.n.* (3 specimen, NY x3; no elevated parathecial crowns, many punctiform apothecia, areoles reduced). **MINNESOTA.** [COUNTY UNKNOWN]: Mankato, on granite boulders, 29.VI.1899, *B. Fink* (NY; elevated parathecial crowns common). **NEBRASKA.** LANCASTER CO.: near Lincoln, 1.vii.1936, on sandstone, *W. Kiener s.n.* (NY x2; elevated parathecial crowns rare and poorly developed). **NORTH DAKOTA.** OLIVER CO.: TNC's Cross Ranch Preserve, Sanger Ghost Town, 515 m, 4.vi.2007, on old wooden shingles of collapsed roof, *M.K. Advaita* 6122 (NY; pruinose without elevated parathecial crowns); on fence, *M.K. Advaita* 6207 (NY; epruinose with some elevated parathecial crowns); ca. 2 miles SE of Hensler, 518 m, 1.vi.2007, on wood of 100-year-old cedar fence posts, *M.K. Advaita* 5901-A (NY; epruinose without elevated parathecial crowns). **OKLAHOMA.** CIMARRON CO.: Black Mesa State Park, 25.ix.2004, on sandstone, *Steven & Sheila Strawn* 561 (NY). GREER CO.: Quartz Mountain, c. 500 m, 10.iv.2007, on pink granite, *C.A. Morse* 15048 w/ *D. Ladd* (KANU, NY, UCR). **OREGON.** [COUNTY UNKNOWN]: Crater Lake National Park, viii.1941, *F.P. Sipe* 1124 (NY). **SOUTH CAROLINA.** LANCASTER CO.: Forty Acre Rock, 150 m, on granitic flatrock, 5.x.1999, *W.R. Buck* 36740 (NY, elevated parathecial crowns common), *R.C. Harris* 43475 (NY). **SOUTH DAKOTA.** FALL RIVER CO.: TNC Whitney Preserve, Alabaugh Canyon, 975 m, 28.vi.2007, on sandstone, *M.K. Advaita* 6233 (NY), *M.K. Advaita* 6237 (NY). MARSHALL CO.: Sicca Hollow State Park, Spirit Trail, ca.486 m, 12.v.2007, on granite boulder, *M.K. Advaita* 5769 (NY). McCOOK CO.: Lake Vermillion Recreational Area, 448 m, 19.v.2008, on granite boulder, *M.K. Advaita* 6689 (NY, elevated parathecial crowns rare and under-developed). McPHERSON CO.: TNC Ordway Preserve, 975 m, 26.iv.2007, on granite, *M.K. Advaita* 5311 (NY). **UTAH.** UINTA CO.: Ashley National Forest, vicinity of Leidy Peak, 3383 m, 31.vii.2009, on granite, *W.R. Buck* 55108 (NY). **WISCONSIN.** BROWN CO.: southwest of Dyckesville, 3.vii.1953, on glacial boulders in field, *W.L. Culberson* 3024 (NY; determined as *A. veronensis* by A.H. Magnusson)

Comparative specimens of Acarospora veronensis examined. – **HUNGARY.** [mountains, handwriting uncertain], 280 m, viii.1926, on volcanic rock, *F. Fóris s.n.* (NY). **ITALY.** [location data unreadable]: *Man. Lich. Ital.* 64 (NY). **NORWAY.** HORDALAND: 760-790 m, on schist, *J.J. Havaas s.n.* (NY); **OPLAND:** Ringebu, 22.vi.1928, on stone fence, *A.H. Magnusson* 11373 (NY). **SWEDEN.** HALLAND: 1.x.1929, *C. Stenholm s.n.* (NY). **U.S.A.** **CALIFORNIA.** LOS ANGELES CO.: San Gabriel Mountains, sine date, on granite, *C. C. Kingman* (FH). SANTA CRUZ CO.: Santa Cruz Mountains, ca. 120 m, 30.xi.1906, on sandstone, *A.C.T.W. Herre* 1094 (NY). **MISSOURI.** MARIES CO.: Spring Creek, 4.xi.2002, 240-320 m, on sandstone, *W.R. Buck* 42751 (NY). **TEXAS CO.:** Gist Ranch Conservation Area, 4.x.2002, on dolomite and chert, *W.R. Buck* 47515 (NY).

2) *Acarospora janae* K. Knudsen in Lumbsch et al., Phytotaxa, 18: 11. 2011. TYPE: U.S.A. NEW MEXICO. SAN MIGUEL CO.: Las Vegas, i.1927, on sandstone, *Bro. Arsène Brouard* 19568 (FH!, holotype; US!, isotype).

Syn. *Acarospora* “*punctata*” R.C. Harris & Ladd ined.

FIGURE 4A, C & E (PAGE 53).

DISCUSSION. – For a description of this species and an image of a form with an especially scabrid disc see Lumbsch et. al. (2011). A typical specimen is illustrated here (fig. 4A, C & E). This species was originally reported from North America as *Acarospora gallica* H. Magn. (Magnusson 1929, 1930) but all specimens cited by Magnusson that are still available have been examined (specimens in herbarium of Bouly de Lesdain were presumably destroyed during WWII) and are *A. janae*. We do not recognize *A. gallica* as occurring in North America and consider it a species which becomes squamulose with a pale underside. Like *A. gallica*, in certain microhabitats, *A. janae* can produce areoles with several apothecia in eastern North America, but this form is rare. The production of multiple apothecia on an areole typically precedes the eventual division of the areole into multiple individuals each with a single apothecium. In some cases there is a dissolution of the thalline borders between the apothecia so they merge together. In one specimen from calcareous sandstone (*Lendemmer* 16929, NY!), *A. janae* was slightly pruinose but typically it is epruinose. In the holotype the lower surface is poorly developed and was described as white (Lumbsch et al. 2011). In the newly discovered isotype at US it is brown. In some of the specimens examined from South Carolina and Newfoundland the lower surface appears melanized and darker. This

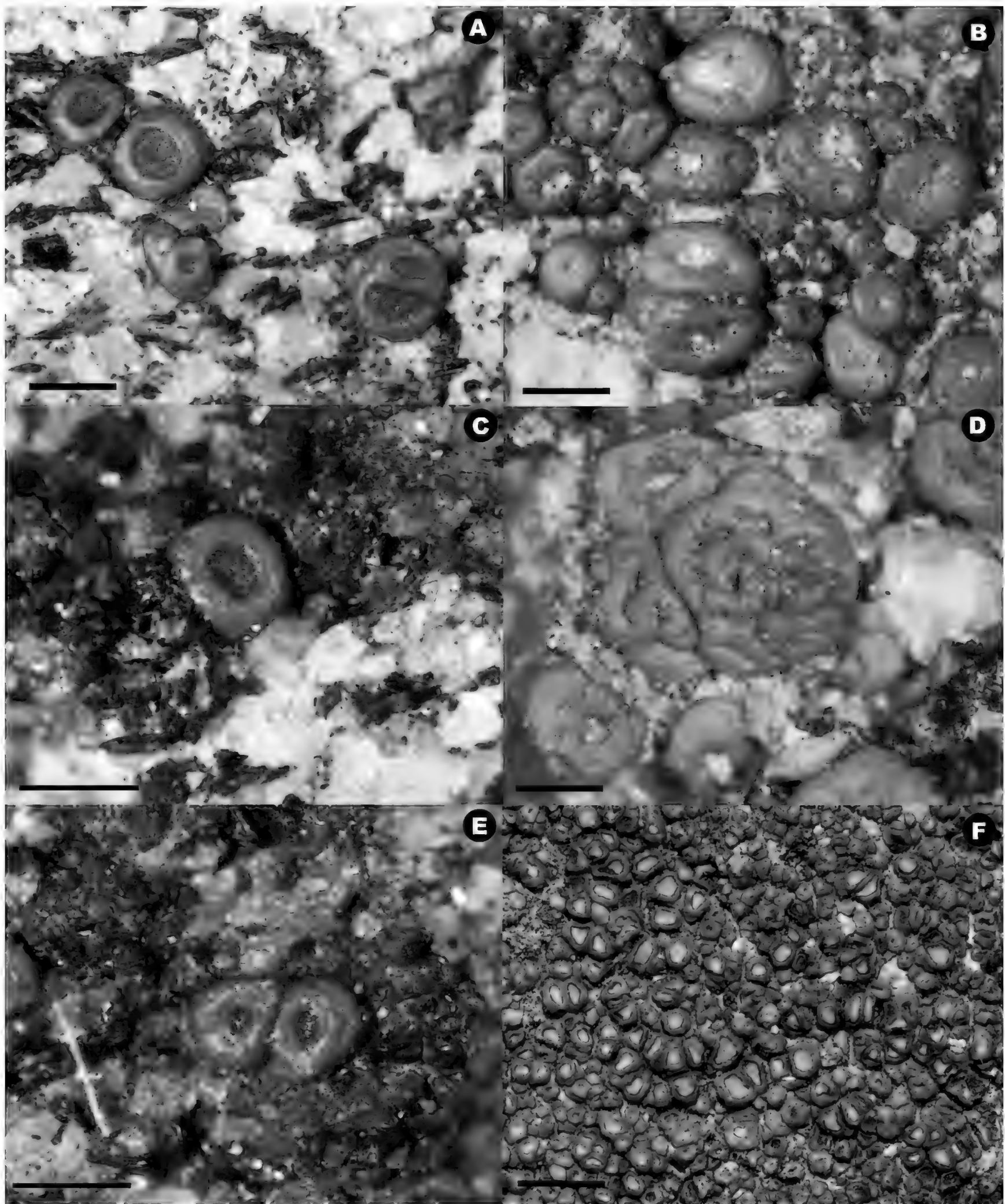


Figure 4, *Acarospora janae* and *A. obpallens*. A,C & E, typical areoles and apothecia of *A. janae* (Buck 35075; scales = 0.5 mm). B & D, sterile immature areoles of *A. obpallens* showing pitting, an ontogenic character of the species (Knudsen 635; scales = 0.5 mm). F, mature thallus of *A. obpallens* photographed by Rolf Muerter in the Santa Ana Mountains of southern California, U.S.A. (scale = 3 mm).

may be caused by substrate interaction. It is possible that the color of the lower surface is a variable character and this may be true in several other species in the family. A key to the North American species of *Acarospora* that produce gyrophoric/lecanoric acids, including *A. janae*, is provided below in the appendix.

Acarospora obpallens (Nyl. ex Hasse) Zahlbr is a saxicolous species which also grows on sandy soil especially along the California coast. It is easily distinguished from *A. janae* by its areoles which have pitted surfaces. These are interpreted as the initials of apothecia. This ontogenic character is illustrated here (fig. 4B, D & F). Once one initial becomes fertile the rest usually do not become fertile but persist. Under environmental stress, no apothecia form and the thalline wall between the pits may erode hollowing the areoles as in the specimen reported in McCune and Rosentreter (2007: 82-83). Mature specimens can become quite rugulose (see image of *A. obpallens* in Knudsen et al. (2008)) and be hard to distinguish from *A. janae*, but usually some pits can be found. Fortunately the two species have very different ranges. *Acarospora obpallens* is rare in eastern North America (Knudsen 2006), but is common in southern California and Arizona (Knudsen 2007). *Acarospora janae* occurs from New Mexico eastward.

The widespread *Acarospora thamnina* (Tuck.) Herre of North America and the Urals is usually shinier than *A. janae*, often has a stipe, and always has a black lower surface (Knudsen 2007). *Acarospora fuscata* (Schr.) Th. Fr. is also widespread and common throughout temperate eastern North America. It differs from *A. janae* in having an areolate thallus, with individual areoles that can become quite lobulate in enriched or moist habitats and a lower surface that is usually black. Occasionally, especially on uneven rock surfaces, *A. fuscata* has round areoles with a single apothecium, usually dispersed around the edges of a contiguous thallus, potentially causing confusion with *A. janae*. For users of the Ozark keys (Harris & Ladd 2005), this taxon was given the tentative name "*A. punctata*".

Specimens examined. – **CANADA. NEWFOUNDLAND AND LABRADOR.** NEWFOUNDLAND: *sine loc.*, 1887, on granite, A.C. Waghorne 543 (US). **U.S.A. ARKANSAS.** POPE CO.: Ozark National Forest, Cowan Hollow, 400 m, 7.xi.2002, on sandstone, A. Amtoft 621 (NY); King's Bluff, 550 m, 7.xi.2002, on sandstone, R.C. Harris 46846 (NY). **COLORADO.** EL PASO CO.: Colorado Springs, Garden of God, 8.X.1927, on white sandstone, C.C. Plitt s.n. (UPS). **KANSAS.** CHEROKEE CO.: N. of SE Bagdad Road, near Missouri border, 31.x.2000, on limestone, W.R. Buck 38528 (NY), W.R. Buck 38534 (NY); Spring River Wildlife Area, 13.ix.2004, on sandstone along small stream, R.C. Harris 48861 (NY), R.C. Harris 48883 (NY). **GEORGIA.** HANCOCK CO.: along GA15, 18.x.1999, on granitic flatrock, W.R. Buck 36688 (NY). JASPAR CO.: Charlie Elliot Wildlife Management Area, 22.vii.2006, S.Q. Beeching s.n. (NY). **MISSOURI.** CARTER CO.: Peck Ranch Conservation Area, near Stegall Mountain, 350-410 m, 12.x.1997, on rhyolite and igneous rock, R.C. Harris 41443 (NY), R.C. Harris 41452 (NY), R.C. Harris 41438 (NY), E. Lay 97-0248 (NY); same location, 16.iv.1997, R.C. Harris 40403 (NY). ST. FRANCOIS CO.: w of Knob Lick Fire Tower, 19.ix.1990, on rhyolite, W.R. Buck 18027 (NY). WASHINGTON CO.: Hughes Mountain Conservation Area, 3.xi.2002, on rhyolite, W.R. Buck 42660 (NY), R.C. Harris 46418 (NY). **NEW MEXICO:** SAN MIGUEL CO.: Las Vegas, *sine date*, on sandstone, A. Brouard s.n. (UPS), A. Brouard 19936 (FH! UPS! paratypes). **OKLAHOMA.** CHEROKEE CO.: J.T. Nickel Family Nature and Wildlife Preserve (J5 Ranch), 30.x.2000, on seepy sandstone flats, R.C. Harris 44304-A (NY). **NORTH CAROLINA.** JACKSON CO.: Cedar Cliff Mountain, 11.x.1998, on schist and gneiss, W.R. Buck 35075 (NY). WAKE CO., Marks Creek County Conservation Area, 75 m, on large cobble, 8.viii.2009, G. Perlmutter 2216 (NCU, UCR, paratypes). **PENNSYLVANIA.** LYCOMING CO.: Tioga State Forest, 274 m, 14.v.2009, on calcareous sandstone, J.C. Lendemer 16929 (NY). TIOGA CO.: Tioga State Forest, 274 m, 14.v.2009, on calcareous sandstone, J.C. Lendemer 16929 (NY). **SOUTH CAROLINA.** [CHESTER CO.]: Chester, 1886, on granite, J.W. Eckfeldt s.n. (US). LEXINGTON CO.: Peachtree Rock Nature Preserve, 150 m, 13.iii.1997, W.R. Buck 31427 (NY). RICHLAND CO.: Fort Jackson Army Base, 125 m, 13.iii.1997, W.R. Buck 31467 (NY).

3) *Acarospora nicolai* B. de Lesd., Lich. Mexique 16 (1914). TYPE: MEXICO. PUEBLA: Tepoxuchitl, *sine date*, *Friar Nicolais s.n.* (W!, lectotype designated by Knudsen and Morse (2009))

DISCUSSION. – *Acarospora nicolai* is a brown species that produces gyrophoric/lecanoric acid (often in low concentrations, detectable only with TLC) and is heavily pruinose. It is known from Mexico (Puebla) and the United States (Kansas, Oklahoma, Texas) and is probably more widespread but relatively infrequent based on current records. For a description and illustration of the species see Knudsen and Morse (2009). Here its range is extended to include Missouri (the Ozarks) and Virginia. The species probably prefers at least weakly calcareous substrates. All the specimens examined were originally identified as *A. fuscata* or *A. umbilicata* Bagl.

Specimens examined. – U.S.A. KANSAS. CHEROKEE CO.: Mined Land Wildlife Area #12, 13.iv.2004, on burned over mine spoils, R.C. Harris 48888 (NY, only specimen seen with little pruina). MISSOURI. TANEY CO.: Ruth & Paul Henning Conservation Area, Dewey Bald, 400 m, 5.x.2002, on seepy dolomite and chert, W.R. Buck 42913 (NY), R.C. Harris 46736 (NY). VIRGINIA. [COUNTY NOT GIVEN] Shenandoah National Park, Skyline Drive, Baldface Mountain Overlook, 11.vi.2006, pebbles on top of wall, P. Farman 1466 (NY).

4) *Acarospora piedmontensis* K. Knudsen sp. nov.

Mycobank #561535.

FIGURE 5 (PAGE 56).

Similis Acarosporae badiofuscae, sed areolis stipitatis.

TYPE: U.S.A. SOUTH CAROLINA. LANCASTER CO.: Forty Acre Rock, ca. 2 mi W of Taxahaw off Co. Rd. 27 at end of Conservancy Road, 34°41'N, 80°31'W, 165 m, 15.iii.1997, on granitic flatrock, W.R. Buck 31607 (NY!, holotype).

DESCRIPTION. – *Hypothallus* endosubstratic. *Thallus* of dispersed areoles, becoming squamules, sometimes contiguous through vegetative division, squamules round or angular especially through division, somewhat flat to convex, mostly 0.5-1 mm in diam., <1.0 mm tall. Stipe developing in all areoles as they mature, less than half the width of squamules. *Upper surface* brown, epruinose, matt, smooth to slightly bumpy. *Rim* downturned, often with black edge visible. *Cortex* subparaplectenchymatous, mostly 20-30 µm thick, the thin upper layer dark brown, lower layer hyaline, without a distinct polysaccharide syncortex or epinecral layer of dead and gelatinized hyphal and alga cells. Cortical cells round to angular, various, intergrading with hyphal bands, the uppermost layer of cells in the cortex with dark pigment hoods caps. *Lower surface* brown becoming black through melanization, often with distinct deep fissures, corticate. *Algal layer* continuous to slightly uneven, sometimes thin, not interrupted by hyphal bundles, alga often in vertical rows, , lower stratum uneven, 60-100 µm, thinner to punctuated beneath apothecium, algal cells mostly 10-12 µm in diam. *Medulla* hyaline, of thin-walled hyphae, 3-4 µm, often branching, continuous with attaching hyphae. *Apothecia* predominately 1 per squamule, infrequently 2-8 punctiform nascent apothecia but usually merging. *Disc* immersed, dull brown, red-brown when wetted, usually round, smooth or scabrid, epruinose, to 1 mm in diam. *Hymenium* hyaline, coherent but loose in KOH, mostly (100-)150-170 µm tall in mature apothecia, epihymenium ca. 10 µm tall, pigmentation light brown, paraphyses mostly 2(-3) µm in diam., apices in pigment caps to 3 µm wide. *Asci* clavate, mostly 60-100 x 15-25 µm, but often infrequent. *Ascospores* hyaline, simple, 4-5 x 2-2.5, mostly broadly ellipsoid. *Subhymenium* 25-40 µm deep, hyaline. *Hypothecium* distinct, of thin hyphae, often 30 µm deep, often a light golden color, sometimes expanding around the disc to 70-80 µm wide, forming a distinct and sometimes elevated parathecial crown the same color as the thallus. Pycnidia mostly 80 µm in diam. Conidia mostly 3 x 1 µm

CHEMISTRY. – No secondary substances detected by TLC. Spot tests: K-, C-, KC-, P-, UV-.

ETYMOLOGY. – The name refers to the ancient eastern North American Piedmont that occurs between the Appalachian Mountains and the Coastal Plain, where the species was discovered and is common.

ECOLOGY AND DISTRIBUTION. – *Acarospora piedmontensis* occurs in open, sunny habitats on granitic outcrops and complexes of granitic slabs, under 400 meters above sea level, associated with *Quercus* species, old-growth junipers, and *Pinus taeda*. It is apparently endemic to the eastern North American Piedmont, which was unglaciated throughout the cycles of the last ice age, where it is known from Georgia and South Carolina. It often forms large solitary patches 10 cm or more in diameter and can be the dominant crustose lichen in some communities.

DISCUSSION. – *Acarospora piedmontensis* is a distinct monomorphic species. Mature squamules are easily identified by a narrow stipe (fig. 5F), dark underside (fig. 5E), and usually a single large immersed apothecium that is red-brown when wetted (fig. 5A-D). Because of its large single apothecia, it could be mistaken for *A. badiofusca* (Nyl.) Th. Fr. s. str. which differs in having broadly attached areoles, a continuous algal layer without a vertical pattern, a shorter hymenium (under 100 µm), and often pseudolecanorine apothecia. *Acarospora badiofusca* is a common montane species of higher elevations in

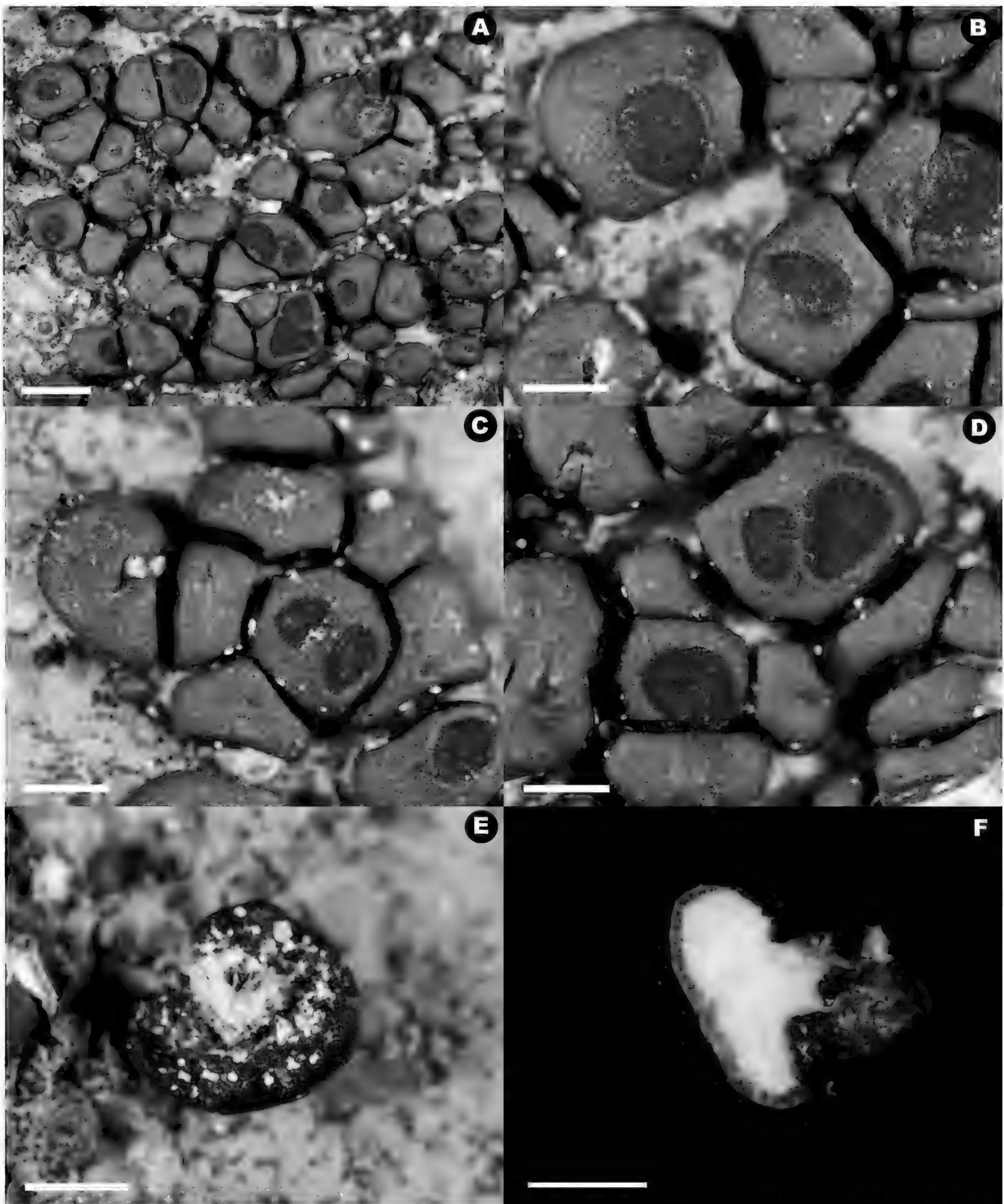


Figure 5, *Acarospora piedmontensis*. A-D, fertile squamules (*Buck 31607*). E, black underside and stipe of squamule (*Buck 31607*). F, cross-section of squamule (*Harris 40158*). Scales = A: 1.0 mm; B-F: 0.5 mm.

North America. Its distribution in eastern North America is not fully understood. However it appears to be very rare and restricted to habitats known to host isolated disjunct lichen populations. Only three specimens of *A. badiofusca* were seen for this study, one from the Great Falls of the Potomac River in Virginia and two from Little Falls, New Jersey. It has likely been extirpated from the latter site. Using the treatment for *Acarospora* in the *Sonoran Flora* (Knudsen 2007), *A. piedmontensis* could be mistaken for *A. obnubila* H. Magn. which has a stipe in well-developed specimens, but differs in having a distinctly interrupted algal layer, a pale lower surface, and a thicker cortex (>70 µm vs. 20-30 µm in *A. piedmontensis*). The two species are also allopatric. *A. obnubila* is a western North American species, frequent in Arizona and southern California.

Specimens of Acarospora piedmontensis examined (all paratypes). – **GEORGIA.** COLUMBIA CO.: Heggie's Rock Preserve, 100 m, 11.iii.2010, on granite, *R.C. Harris* 55817 (NY), *W.R. Buck* 55975 (NY); 6.x.1999, *W.R. Buck* 36511 (NY). PUTNAM CO.: Eatonton Granite Outcrop, along W shore of Oconee Lake, 8.x.1999, *W.R. Buck* 36695 (NY). **SOUTH CAROLINA.** GREENVILLE CO.: downhill from Bald Rock, 335 m, 5.x.1999, E-facing slope of granitic outcrop, *R.C. Harris* 43450 (NY), *R.C. Harris* 43452 (NY), *R. Yahr* 1997 (US); granitic dome on west side of US 276, 14.iii.1997, *W.R. Buck* 31536 (NY). LANCASTER CO.: data as for type, *R.C. Harris* 40158 (NY, mostly sterile).

Specimens of Acarospora badiofusca examined. – **NEW JERSEY.** PASSAIC CO.: Little Falls, 15.ix.1896, *A. Schneider* s.n. (NY); Beech Mountain near Franklin Grove, 1937, *G.G. Nearing* s.n. (NY). **VIRGINIA.** FAIRFAX CO.: Great Falls National Park, along Great Falls on the Potomac, 6.ix.1982, *J.G. Guccion* 1083 (NY).

5) *Acarospora sphaerosperma* R.C. Harris & K. Knudsen sp. nov.
Mycobank #561536.

FIGURE 6 (PAGE 58).

Similis Acarosporae dispersae, sed ascosporis plus minusve globosis 7-10(-12) µm vel late ellipsoideis 7-9 x 5-7 µm.

TYPE: U.S.A. ARKANSAS. IZARD CO.: NE corner of Devil's Knob-Devil's Backbone Natural Area, 36°00'22"N, 92°02'48"W, sandstone and dolomite outcrops, 24.x.2001, on dolomite, *R.C. Harris* 45400-D (NY! holotype).

DESCRIPTION. – *Hypothallus* endosubstratic. *Thallus* of dispersed areoles arising from the substrate, sometimes contiguous especially by vegetative division, covering areas up to 5 cm, usually solitary, rarely mixed with other saxicolous lichens. *Areoles* broadly attached, round to irregular in shape, mostly 0.5-1.0 mm. in diameter, usually less than 0.4 mm high. *Upper surface* waxy white, glossy, turning green when wet, with a red dot (pycnidia or immersed apothecium) in center, then eventually with a superficial reddish brown apothecium with a concolorous or darker concave disc. *Epicortex* absent. *Eucortex* paraplectenchymatous, mostly 10-30 µm tall, uneven in height, cells round, 3-6 µm in diam. to angular and irregular, intergrading with bands of medullary hyphae mostly 10 µm thick interrupting the algal layer; hyaline throughout, only becoming light to dark brown in the area above pycnidia or nascent apothecia forming beneath the cortical layer (the pigment becoming more reddish in K). *Rim* usually concolorous with thallus. *Lower surface* narrow, white, unless blackened by substrate interactions; *Algal layer* 40-200 µm thick, continuous with even strata, algal cells mostly 8-12 µm in diam., thin or punctuated beneath apothecia, medullary hyphae interrupting algal layer in narrow bands, sometimes of only 3 or 4 hyphae, hard to observe, but also single anticlinal hyphae interpenetrating algal layer. *Medulla* hyaline, hyphae thin-walled, 3 µm thick, cells mostly 10 µm long, continuous with attaching hyphae, mostly less than 100 µm thick. *Apothecia* emergent, predominately 1 per areole, rarely 2, first appearing as a brown conical swelling (looking like the pycnidia), expanding beneath the cortical surface, becoming fertile before eventually the cortical layer is ruptured at the apex of the areole, the punctiform disc exposed, epihymenial pigment thickening, the apothecium becoming elevated, disc eventually dilating up to 0.4 mm, the brown margin formed from cortex. *Disc* inconspicuous, appearing as a red spot at apex of areole, eventually becoming dilated to 0.3 mm in diam, concave, reddish brown, concolorous with margin. *Parathecium* 20-30 µm, continuous with hypothecium, level or lower than epihymenium, at lower substratum of cortex when apothecium is immersed, and remaining at this level when cortex has been breached. *Hymenium* approximately 170-200(-340?) µm, height various, but epihymenium 10-15 µm, reddish brown after disc is

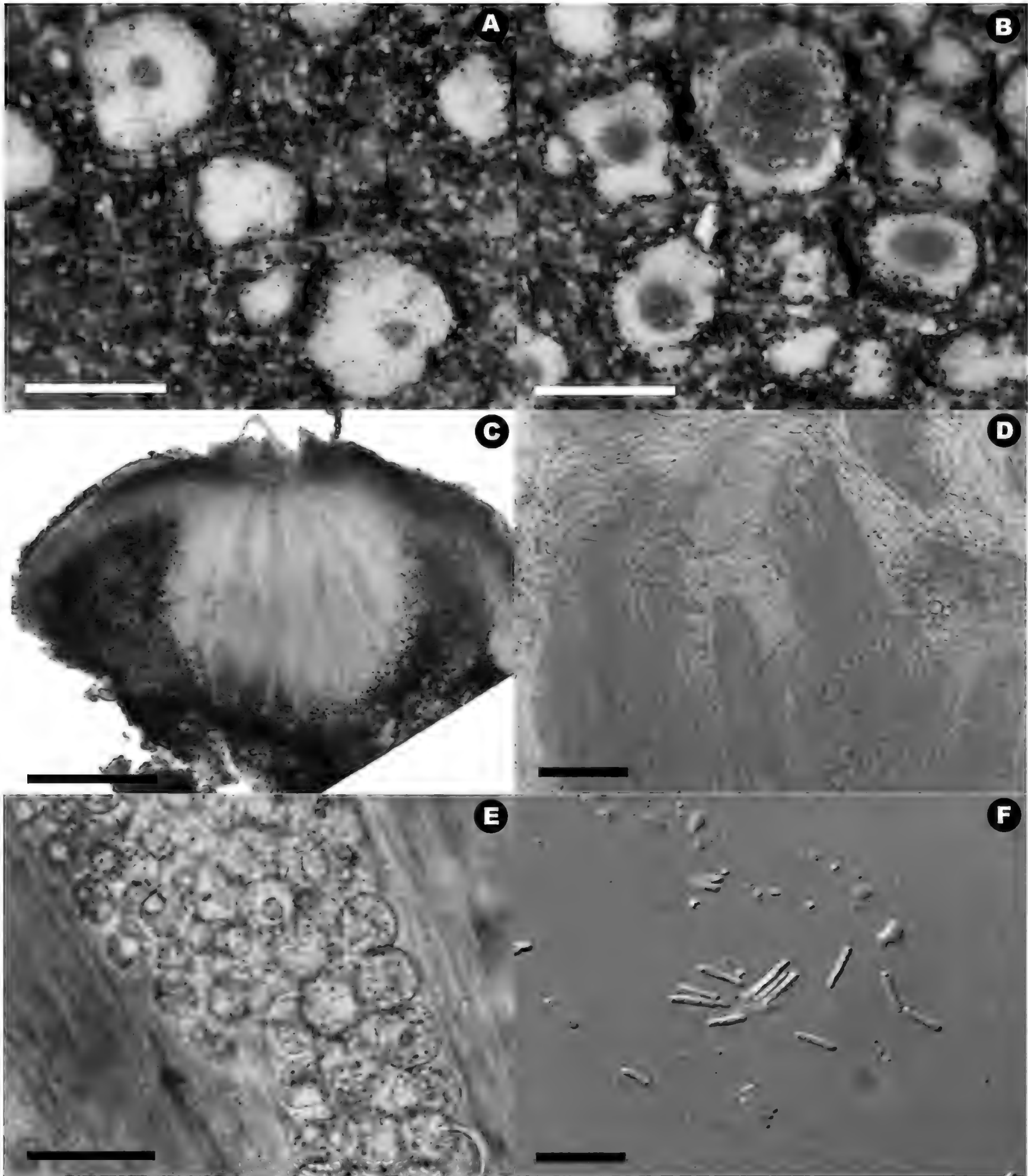


Figure 6, *Acarospora sphaerosperma*. **A**, areoles sterile and with the beginning of emergent apothecia (*Harris 45400D*; scale = 0.5 mm). **B**, areole (center) with fully developed apothecium (*Harris 45400D*, scale = 0.5 mm). **C**, cross section of fertile areole in I (*Harris 45658*; scale = 100 μ m). **D**, hymenium in IKI (*Harris 45400D*; scale = 30 μ m). **E**, globose ascospores in ascus (*Buck 45077*; scale = 20 μ m). **F**, conidia (*Buck 42931*; scale = 10 μ m).

exposed, paraphyses mostly 1.0 μm , lax in water, profusely branching, with oil drops, not constricted at septa, cells usually 5-10 μm , apices slightly expanded, not in pigment caps. Hymenial gel usually I+ blue, with greenish hues, turning red, or I+ red or orange as in Fig. 6D; K/I+ blue. *Asci* *Acarospora*-type, long and cylindrical at first, becoming mostly clavate, 100-130 x 30 μm , 100+ ascospores per ascus, sometimes fewer, then the ascus narrower. *Ascospores* simple, hyaline, quite various, spherical, 7-10(-12) μm , or broadly ellipsoid 7-9 x 5-7 μm (ascospores this broad can look round in the ascus depending on plane of observation). Subhymenium 30-40 μm , I+ blue. Hypothecium continuous with parathecium, 20-30 μm , deep. *Pycnidia* rare, with many nascent apothecia. *Conidia* 5-6 x 1-1.3 μm , rod-shaped.

ETYMOLOGY. – The name refers to the predominantly spherical ascospores.

CHEMISTRY. – No substances detected. Spot tests: K-, C-, KC-, P-, UV-.

ECOLOGY AND DISTRIBUTION. – *Acarospora sphaerosperma* is a calciphile, occurring on limestone, and on dolomite and chert in dolomite-chert glades in Missouri. The specimen from Ohio was on a pebble in a prairie with alkaline soil.

DISCUSSION. – *Acarospora sphaerosperma*, like *A. dispersa* H. Magn., has its center of distribution in the Ozarks. Large ascospores easily distinguish the new species from *A. dispersa* which has mostly narrow ellipsoid ascospores, 4-6 x 1 μm . Though they can look similar and are probably closely related, *A. sphaerosperma* has a different gestalt than *A. dispersa* with its white areoles and red-brown melanized cortical layer around the apothecia. It appears to be a calciphile and is relatively rare.

Specimens examined. – **U. S. A. MISSOURI.** CHRISTIAN CO.: Mark Twain National Forest, N of Turkey Creek Road, 21.v.2003, on dolomite rubble, 29.x.2000, *R.C. Harris* 47701 (NY). GREENE CO.: Wilson's Creek National Battlefield, Bloody Hill, 29.x.2000, on dolomite, *R.C. Harris* 44184 (NY). IZARD CO.: Devil's Knob-Devil's Backbone, 24.x.2001, on limestone, *R.C. Harris* 45400-D (NY). MONTGOMERY CO.: NW corner of Danville Nature Area, 27.x.2001, on limestone, *W.R. Buck* 40577 (NY). ST. LOUIS CO.: Rockwoods Reservation, old limestone quarries, 26.x.2001, on limestone, *R.C. Harris* 45658 (NY). TANEY CO.: Ruth & Paul Henning Conservation Area, Dewey Bald, 400 m, on chert, 5.xi.2002, *W.R. Buck* 42931 (NY). TEXAS CO.: Gist Conservation Area, chert-limestone glade, 4.xi.2004, on chert, *R. C. Harris* 50334 (NY). **OHIO.** ADAMS CO.: Chaparral Prairie State Nature reserve, ca. 265 m, 22.v.2006, on pebble on alkaline soil, *S. Will-Wolf s.n.* in *R.C. Harris* 52809 (NY).

6) *Arthonia interveniens* Nyl., Ann. Sci. Nat. Bot., ser. 4, 20: 235. 1863. TYPE: **U.S.A. SOUTH CAROLINA.** [COUNTY UNKNOWN]: sine loc., sine date, *H.W. Ravenel* 135 (H-NYL #5470 [n.v.], holotype; FH-TUCK #3646! [HUH BARCODE 00304017, fragment marked "s.N. 235 (dimidium[sic]) *A. interveniens*, Nyl. in litt!"], isotype).

Arthothelium interveniens (Nyl.) Zahlbr., Cat Lich. Univers., 2: 127. 1922.

Syn. nov. *Arthonia subcyrtodes* Willey, Synops. Genus Arthonia, p. 51. 1890. TYPE: **U.S.A. FLORIDA.** [COUNTY UNKNOWN]: sine loc., sine date, *W.W. Calkins s.n.* (US!, holotype).

DISCUSSION. – Recently while identifying specimens from southeastern North America we examined Willey's monograph of *Arthonia* (Willey 1890) and noticed the similarity between *A. subcyrtodes* and the common species *A. interveniens*. Examination of the type of *A. subcyrtodes* revealed it is conspecific with *A. interveniens* and thus we formally place it in synonymy here. *Arthonia interveniens* is common throughout southeastern North America and is presently included on the North American Checklist (Esslinger 2010).

7) *Bactrospora carolinensis* (Ellis & Everh.) R. C. Harris comb. nov.
Mycobank #561537.

Patellaria carolinensis Ellis & Everh., J. Mycol., 1: 152. 1885. TYPE: **U.S.A. SOUTH CAROLINA.** [COUNTY UNKNOWN]: sine loc., on dry bleached wood, *H.W. Ravenel* 680 (NY!, holotype).
Scutularia carolinensis (Ellis & Everh.) Sacc., Syll. Fung., 8: 808. 1889.

Syn. nov. *Bactrospora mesospora* R. C. Harris, Some Florida Lichens, p. 40. 1990. TYPE: **U.S.A. FLORIDA**. NASSAU CO.: just E of Lofton Creek on Fla. Hwy. A1A, 5.5 mi W of Amelia River, hardwood swamp, 17.xii.1987, on *Acer*, R.C. Harris 21152 (NY!, holotype).

DISCUSSION. – While reviewing type specimens of *Patellaria* at NY, one of us (RCH) discovered that the type material of *Patellaria carolinensis* Ellis & Everh. is conspecific with *Bactrospora mesospora* R.C. Harris. Since *P. carolinensis* has priority it is transferred to *Bactrospora* here and *B. mesospora* is placed in synonymy. According to Ellis's notes Rehm suggested the new species was a lichen, but Ellis decided otherwise. Interestingly at this period Müller Argoviensis was using *Patellaria* auct. as a name for *Bacidia* spp. (see synonymies in Ekman (1996)), although there is no indication that Ellis was using *Patellaria* in this sense. For a description and illustration of this taxon see Egea and Torrente (1993).

8) *Lecanora zeroensis* Lendemer sp. nov.

Mycobank #561538.

FIGURE 8A-D (PAGE 64).

Similis *Lecanora caesiorubella* subsp. *merrillii* sed apotheciis epruinosis et epihymenio rubrofusco

TYPE: **U.S.A. GEORGIA**. PIERCE CO.: Little Satilla Wildlife Management Area, Knight Road ca. 2 mi E of Offerman, between Zero Bay and Sixty Foot Branch, 31.38635N 82.08204W, *Persea-Magnolia-Acer* strand wetland/bayhead, on *Acer*, 21.xii.2009, J.C. Lendemer et al. 21510 (NY!, holotype; hb. Kalb!, isotype).

DESCRIPTION. – Thallus continuous to rimose-areolate, esorediate, corticate; cortex 40-80 μ m thick, prosoplectenchymatous; algal layer uneven, 20-40 μ m thick; apothecia sessile, [0.4]-(0.6)-0.8-(1.1)-[1.5] mm in diam. (n= 40); disc dark reddish-brown, epruinose; margin lecanorine, prominent, smooth, entire, with a the proper exciple visible as a distinct hyaline inner “ring”; thalline exciple with a poorly defined cortex or fully ecorticate, heavily inspersed with small crystals, 80-120 μ m thick; proper exciple hyaline, prosoplectenchymatous, 20-30 μ m thick; epihymenium reddish-brown, with crystals, both pigmentation and crystals dissolving in KOH; hymenium hyaline, not inspersed, 60-90 μ m tall; hypothecium hyaline, not inspersed, 60-70 μ m thick; paraphyses simple to weakly branched, not apically expanded; asci *Lecanora*-type; ascospores hyaline, 8/ascus, simple, [8.4]-(8.6)-9.6-(10.6)-[11.4] x [5.0]-(6.1)-7.2-(8.2)-[8.5] (n= 20). Photobiont green, coccoid, (7.4)-10.3-(8.6)-[12.6] μ m in diameter (n= 40). Pycnidia not seen.

CHEMISTRY. – Atranorin, norstictic acid, and connorstictic acid. Spot tests (cortex and thalline margin): K+ yellow turning red (forming red crystals in squash mount), C-, KC-, P+ yellow, UV-.

ETYMOLOGY. – The epithet “zeroensis” refers to the type locality, Zero Bay, which lacks standing water and is part of the forested wetlands associated with the Little Satilla River.

ECOLOGY AND DISTRIBUTION. – The new species is known only from the type locality where it was collected on the bark of a maple (*Acer*) in a remnant hardwood strand wetland/bayhead bisected by a powerline cut. It is likely that the species occurs elsewhere in the region and that it has simply been overlooked because of its superficial resemblance to members of the *Lecanora subfusca* group. It is noteworthy however, that the species has not been encountered during extensive fieldwork in adjacent Florida.

DISCUSSION. – *Lecanora zeroensis* is a highly distinctive and somewhat enigmatic species that combines different aspects of the *L. caesiorubella* and *L. subfusca* groups. Superficially the species resembles a member of the *L. subfusca* group because of its reddish-brown pigmented epihymenium. However the excipular anatomy is identical to that of *L. caesiorubella* s.l. and the chemistry is also comparable to members of that group (Lumbsch et al. 1997). The new species is readily recognized by its pigmented epihymenium, apothecia with epruinose discs, the absence of a cortex on the thalline margin of the apothecia, and the presence of norstictic acid.

A similarly puzzling species with norstictic acid, *L. vacillans* H. Magn., was treated in detail by Lumbsch and Guderley (1997). That species combines characters of the *L. subcarnea* and *L. subfusca* groups, is saxicolous, known only from Sweden, and differs from *L. zeroensis* in a number of morphological respects (most notably the presence of a cortex on the margins of the apothecia).

9) *Melanophloea americana* K. Knudsen & Lendemer sp. nov.

Mycobank #561539.

FIGURE 7 (PAGE 62).

Similis Melanophloeae pacificae, sed ascosporae 4-5 x 1 µm et saxicola.

TYPE: U.S.A. PENNSYLVANIA. MONTGOMERY CO.: Pennypack Watershed, xi.1987, on silicate rock, *A. Aptroot 21376* (NY, holotype).

DESCRIPTION. – Thallus absent. Ascomata arising from the substrate individually, superficial, dispersed or congregated, especially on uneven surfaces, hemispherical and black, remaining black when wetted, 0.1-0.5 mm in diam., to 0.3 mm high, circular area conspicuous at apex of ascoma, to 0.1 mm in diam., hyaline and concave in center, formed of apices of interascal filaments surrounded by narrow excipular ring, pale yellowish-brown, sometimes slightly raised. Infrequently ascomata compound with two-four hymenia separated by exciple layer and then with 2-4 openings, not centered at apex of ascomata. Wall of ascomata to 80 µm thick. Outer wall of ascomata 10-30 µm thick, paraplectenchymatous, carbonized, with inner thalline area subparaplectenchymatous, of hyaline hyphae, 10-50 µm thick, with scattered lichenized green chlorococcoid algal cells, to 10 µm. Exciple distinct, of narrow hyaline hyphae 10-20 µm thick. Hymenium usually 150-225 µm high (measurement including subhymenium), I+ blue. Interascal filaments abundant, 0.5-1.0 in diam., moderately branching, apices unexpanded. Asci cylindrical to narrowly clavate, mostly 100-135 x 15-35 µm, 200+ ascospores per ascus, contents of ascus I+ orange-red when ascospores mature. Outer wall of ascus I-. Indistinct I+, K/I+ narrow blue stain of at least the upper endoascus wall. Ascospores simple, hyaline 3-5 x 0.5-1 µm. Hypothecium indistinct. Whole ascomata subtended by layer of gelatinized intricate narrow hyphae to 50 µm thick, I-, substrate, sometimes with a few algal cells, attaching ascomata to substrate. Conidiomata not observed.

CHEMISTRY. – No substances detected. Spot tests: K-, C-, KC-, P-, UV-.

ETYMOLOGY. – The name refers to North America where the species was discovered.

ECOLOGY AND SUBSTRATE. – The species occurs on silicate rocks in riparian areas. The holotype has soil deposits from flooding.

DISTRIBUTION. – Currently known only from two localities in southeastern Pennsylvania and one in New York. These localities represent small fragments of a once intact natural landscape that has been almost entirely transformed by agriculture and urbanization. Either the species is naturally rare and restricted to riparian areas or it was once more common and its range has been reduced through anthropogenic change. Regardless, suitable habitats in southeastern Pennsylvania should be examined for this species to determine its current status and any potential conservation/management needs.

DISCUSSION. – The genus *Melanophloea* P. James and Vězda belongs to the family Thelocarpaceae (James & Vězda 1991; McCarthy 2008; McCarthy & Kantavilas 2009). It is distinguished from *Thelocarpon* Nyl. mainly by having an ascomatal wall of non-periclinial hyphae with a melanized outer layer that is greenish black to red-brown, which can become quite carbonized in *M. pacifica* P. James and Vězda, the type of the genus. *Melanophloea pacifica* is an epiphytic crust on the bark of rainforest trees from the Solomon Islands, Papua New Guinea, and Australia. Besides being corticolous, *M. pacifica* differs from *M. americana* in having globose ascospores, 2-3 µm in diameter. Like the new species, *M. montana* P.M. McCarthy, which is known only from the type locality in the deep shade of a montane rainforest in Australia, is saxicolous on silicate rocks. That species differs in having sparse interascal filaments when mature, an exciple expanding near the apex of the ascoma, a K/I+ blue-black hymenium, and larger ascospores (4-6 x 2-3 µm vs. 3-5 x 0.5-1 µm). Based on the carbonized wall of the ascoma, the corticolous taxon *Thelocarpon nigrum* Aptroot & K.H. Moon from Korea probably belongs in *Melanophloea* (Aptroot

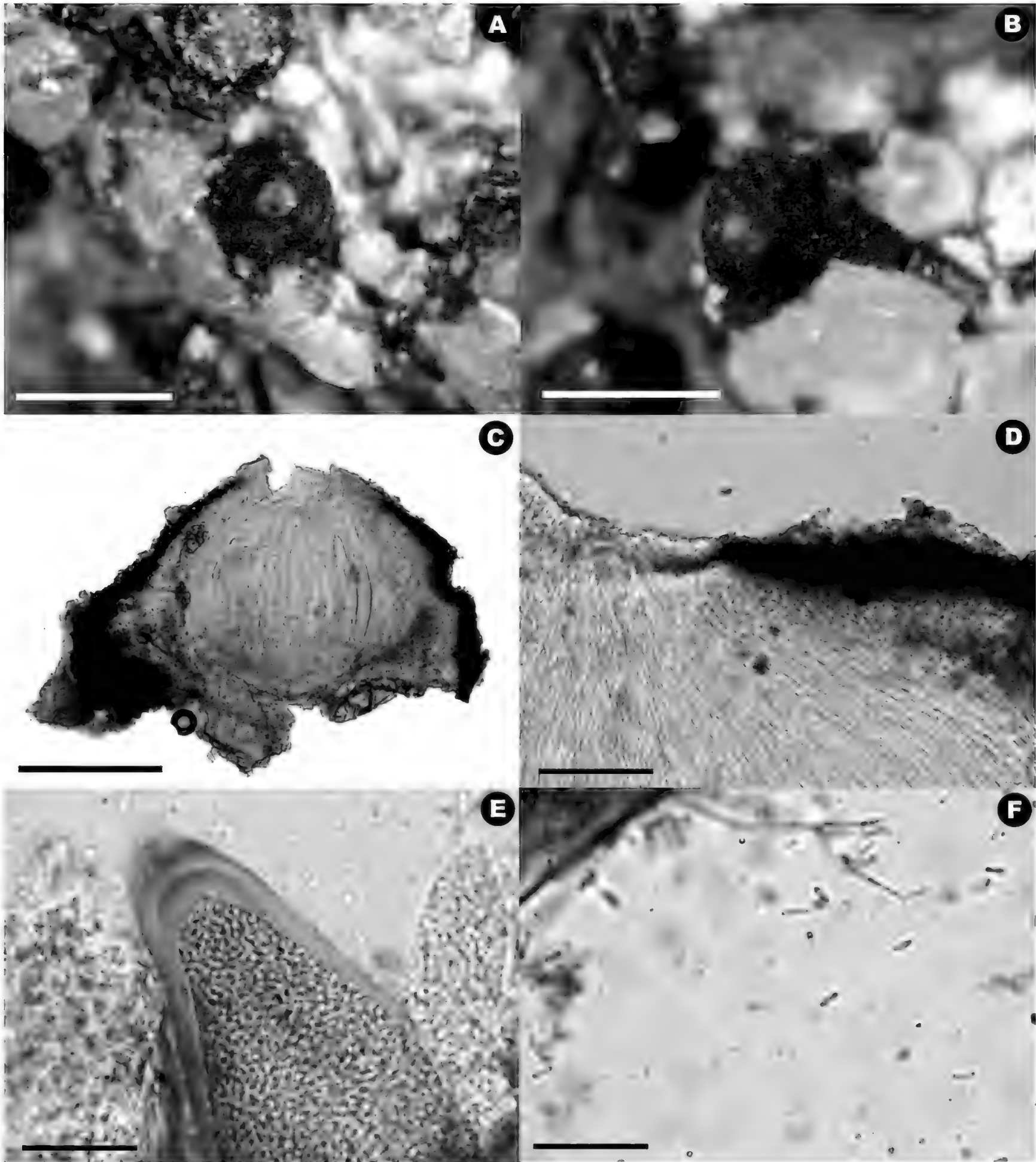


Figure 7, *Melanophloeae americana* (all from Aptroot 21389). A & B, ascomata (scale = 0.5 mm). C, cross-section of ascomatium, note that scattered algal cells are not apparent (scale = 200 μ m). D, apex of ascomatium (scale = 50 μ m). E, ascus tip in IKI (scale = 20 μ m). F, ascospores (scale = 20 μ m).

& Moon 2009). It differs from *M. americana* in having thicker interascal filaments (2-2.5 μm) and larger ascospores (9-12 x 5-6 μm).

There is some variation in the staining reactions of the ascus and hymenium among the species of *Melanophloea*. Similar variation is observed in *Thelocarpon*, which molecular phylogenetic studies indicate is monophyletic (Lumbsch et al. 2009, Salisbury 1996, Kocourková-Horáková 1998). In the family Thelocarpaceae these differences are used only for species delimitation at this time. This is the first report of the genus *Melanophloea* from North America.

Other specimens examined (paratypes). – **U.S.A. NEW YORK.** WESTCHESTER CO.: Ward Pound Ridge Reservation, near Cross River, 2.x.1981, on old rock wall, *R.C. Harris 14023* (NY). **PENNSYLVANIA.** YORK CO.: slopes above W-shore of Susquehanna River, 165 m, 20.v.2009, on silicate rock, *J.C. Lendemer 18013-B* (NY).

Specimen of Melanophloea pacifica examined. – **PAPUA NEW GUINEA. MANDANG PROV.:** foothills of the Finisterre Range, 31.x.1995 to 2.xi.1995, *E. Sérusiaux et al. s.n.* (NY).

10) *Polysporina cyclocarpa* (Anzi) Vězda, Folia Geobotanica et Phytotaxonomica, 13(4): 399. 1978.
TYPE: ITALY: “Sulla dolomia variegata silicifera dal monte Sassalbo sopra Poschiavo”
(holotype not located; BM[n.v.], isotype).

FIGURE 8E & F (PAGE 64).

DISCUSSION. – *Polysporina cyclocarpa* is here reported for the first time from continental North America (Connecticut, Missouri, New York, and West Virginia). It has previously been reported from Greenland (Knudsen & Kocourková 2009). In the past the first author reviewed an E. Lay collection from the Ozarks, which he determined as *P. cyclocarpa*. We were unable to borrow this specimen again to confirm the determination following the revision of western populations as *P. gyrocarpa* (H. Magn.) N.S. Golubk. Based on this specimen the Ozarks are included in the range of *P. cyclocarpa* in continental North America. Most of the specimens cited below were identified as *Sarcogyne privigna* (Ach.) A. Massal., which *P. cyclocarpa* resembles because of the angular edges of its often compressed or vegetatively dividing apothecia, which sometimes even look star-shaped. Like other *Polysporina* species, the disc may at first have no epihymenial accretions. For a full description of *P. cyclocarpa* see Knudsen & Kocourková (2009). The description of *P. cyclocarpa* in the *Sonoran Flora* (Knudsen & Stanley 2007) actually describes *P. gyrocarpa*, a species of Asia and western North America.

Since *Polysporina cyclocarpa* is allopatric with *P. gyrocarpa* in North America, identifications in eastern North America are relatively easy based on the hymenium height (~80-100 μm tall), rarely branching paraphyses that are ~2 μm wide, ascospores ~4-5 x 2 μm , and occurrence on calcareous rock or soft granite in mesic conditions. *Polysporina simplex* is also frequent in eastern North America where it almost always occurs on silicate rock and looks similar to *P. cyclocarpa*. That species generally has smaller apothecia, often thinner more branching paraphyses, and on an average has narrower ascospores, with many closer to 0.5 μm in width. The overlapping size ranges of many morphological features between different species make species in this genus difficult to identify, but only two species are common in North America: *P. simplex* and the lichenicolous fungus *P. subfuscescens* (Nyl.) K. Knudsen & Kocourková.

Polysporina cyclocarpa is a calciphile. It was described from dolomite and also occurs on hard limestone in the Alps (Knudsen & Kocourková 2009). The specimen from the Ozarks occurred on dolomite and the specimen from Jefferson County, New York was found on limestone. The other specimens were collected on porous, relatively soft granite associated with swamps and wetlands where the water is probably rich in dissolved calcium ions. All the eastern North American specimens were large (ca. 1 mm.) and even looked larger (to ca. 2 mm) when in the process of vegetative division. The algal layers were especially well-developed, much more than in specimens seen from the Alps (Knudsen & Kocourková 2009).

Specimens examined. – **U.S.A. CONNECTICUT.** WINDHAM CO.: Eastford, Natchaug State Park, Cat Den Swamp, red maple swamp, 19.ix.2009, on granite with *Acarospora fuscata*, *Sarcogyne privigna*, and *S. sp.*, *R.C. Harris 55703* (NY). **NEW YORK.** JEFFERSON CO.: Three Mile Creek Barrens, hardwood swamp forest, 25.v.199, on adjacent alvar limestone pavements, *R.C. Harris 40852* (NY). **ROCKLAND CO.:** Harriman State Park, 9.iii.2008, on granite dome between *Sphagnum* depressions, ca. 304 m, *J.C. Lendemer 11525* (NY). **WEST VIRGINIA.** TUCKER CO.: Blackwater Falls State Park, 945 m, on rock, open fields and wetlands, 23.iv.2001, *R.C. Harris 44925* (NY).

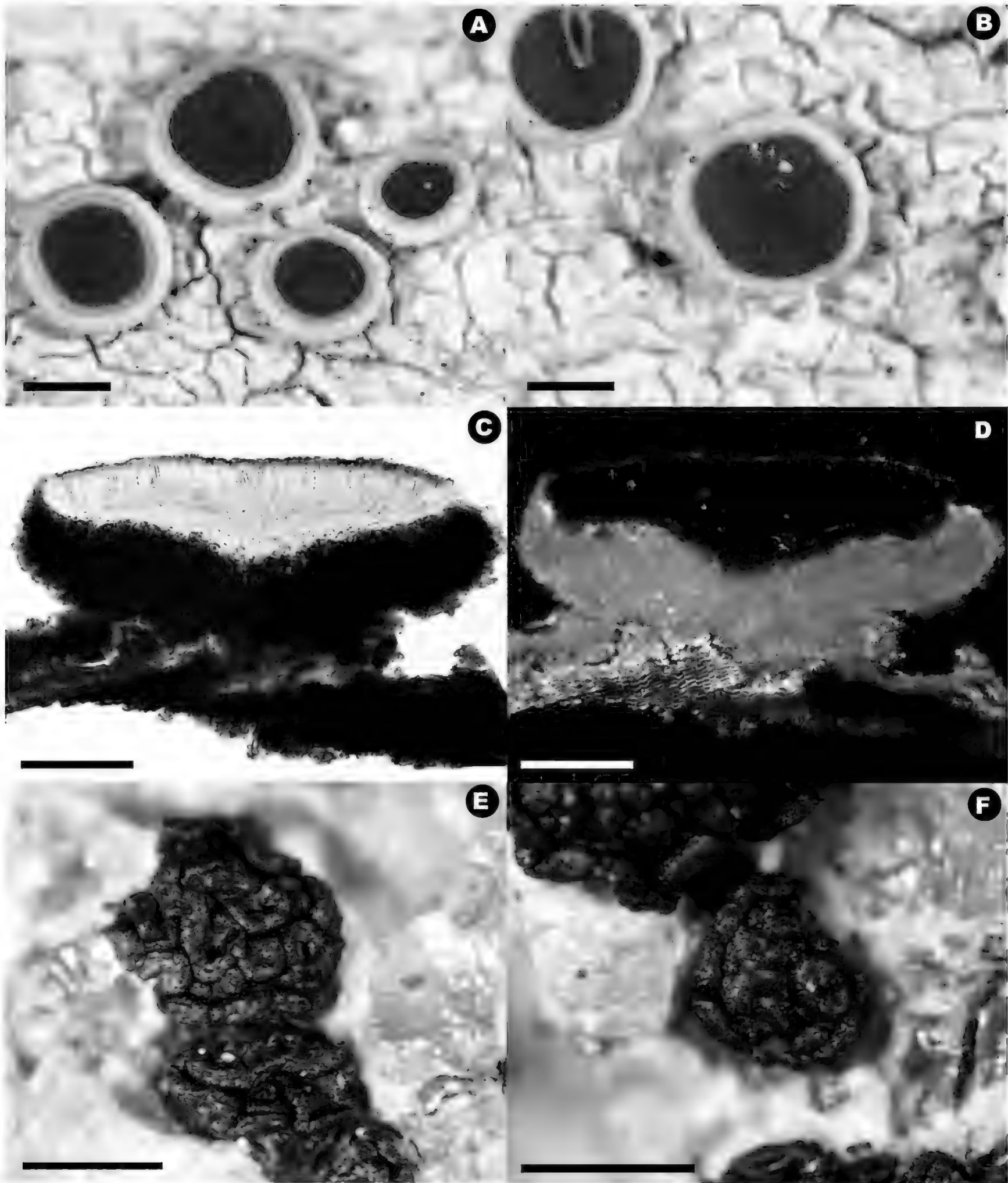


Figure 8, *Lecanora zeroensis* and *Polysporina cyclocarpa*. A-B, apothecia of *L. zeroensis* (holotype; scales = 0.5 mm). C-D, section of apothecium of *L. zeroensis* in water and polarized light respectively (holotype; scales = 200 μ m). E-F, mature apothecia of *P. cyclocarpa* (Lendemer 11525; scales = 0.5 mm).

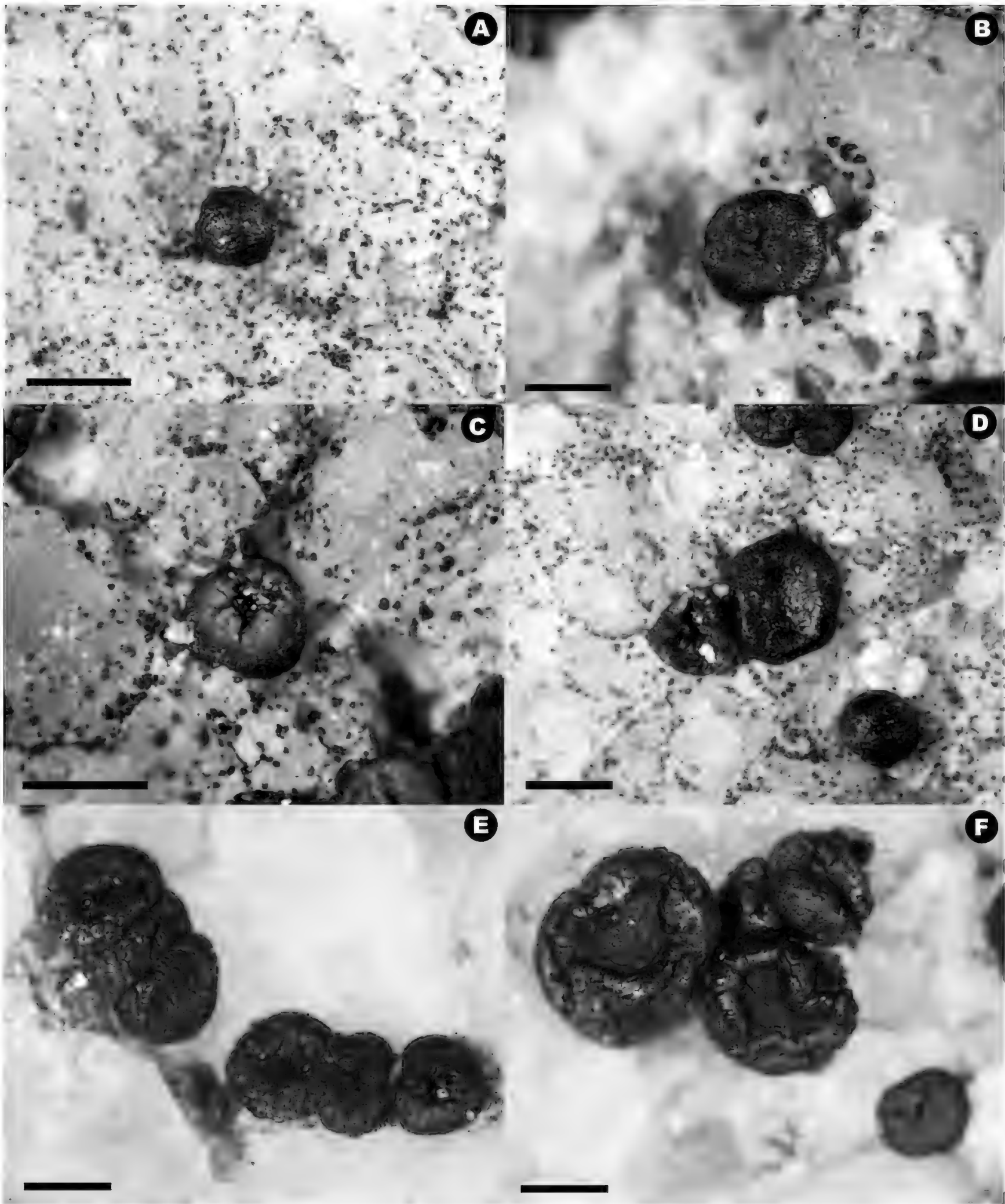


Figure 9, *Sarcogyne reebiae*. A, stroma containing a pycnidium (*Buck 36693*; scale = 0.5 mm). B & C, Stromata decaying as apothecia emerge (*Buck 36693*; scales = 0.5 mm). D, old apothecium in center. (*Buck 36693*; scale = 0.5 mm). E & F, Young donut-shaped apothecia (*Hodkinson 10208*; scales = 0.5 mm).

- 11) *Sarcogyne reebiae* K. Knudsen in Nash et al., Lichen Flora of the Greater Sonoran Desert Region, 3: 294. 2007. TYPE: U.S.A. CALIFORNIA. ORANGE CO.: Santa Ana Mountains, Weir Canyon, N-facing sandstone outcrop in mesic mixed chaparral, 33°50'18"N, 117°44'08"W, 6.vi.2006, on sandstone, K. Knudsen 6435 (UCR!, holotype; ASU!, isotype).

FIGURE 9 (PAGE 65).

DISCUSSION. – *Sarcogyne reebiae* is rare in California where it occurs on sandstone and granite. It is only known from Weir Canyon in the Santa Ana Mountains, the Meniffee Hills in Riverside County, and Topanga Canyon in the Santa Monica Mountains, all areas with a coastal influence (Knudsen & Standley 2007). It is here reported new to southeastern North America from Alabama, Georgia, Kentucky, Virginia, and West Virginia. *Sarcogyne reebiae* produces abundant black sessile stroma in which large, 1-locule pycnidia form. The conidiogenous cells are 10-15 x 0.5-1.0 µm and produce abundant small hyaline conidia 2-3 x 0.5-2 µm. In a fascinating ontogeny, the conidiogenous cells atrophy and the stromatal wall begins to decay as an apothecium develops, unfolding to form at first a donut-shaped ascocarp with a thick excipulum. Eventually the apothecia expand, forming a flat disc, with a relatively narrow black to yellowish-brown margin. The mature margin is rarely incised; if so, then usually vegetatively dividing. The epruinose disc is red-black to bright red when wetted. The width of the exciple (up to 100 µm), the height of the hymenium (60-100 µm), and paraphyses size (2 µm wide) overlaps several described species of *Sarcogyne* in North America. The ascospores are not helpful for determination either, because of variability, but most are narrowly ellipsoid (4-5 x 1-1.5 µm). It is most easily identified by the association of the apothecia with the superficial pycnidia. Most southeastern specimens seen had a scabrid disc.

The robustness of the eastern specimens suggest that the southern California populations are relicts from an earlier, moist ice age climate, and are possibly becoming naturally extirpated by the development of a Mediterranean climate. Unfortunately the expected increased aridity in California from global warming will accelerate this process.

Specimens examined. – U.S.A. ALABAMA. JACKSON CO.: Flat Rock, 2.x.1999, on sandstone, W.R. Buck 36345 (NY), W.R. Buck 36347 (NY). MARION CO.: North Fork Creek, 4.x.1999, on sandstone, W.R. Buck s.n. (NY). GEORGIA. BATH CO.: Daniel Boone National Forest, Tater Knob, 10.x.1995, on sandstone, W.R. Buck 28486 (NY, old apothecia with scabrid discs, vegetatively dividing). COFFEE CO.: Broxton Rocks Ecological Preserve, 7.x.1999, on Altamaha Grit sandstone, W.R. Buck 36582 (NY), W.R. Buck 36605 (NY). HEARD CO.: Camp Meeting Rock Preserve, ca. 250 m, 1.x.1999, on granite flatrock, W.R. Buck 36275 (NY, pycnidia lacking, apothecia unusually small with incised margins, vegetatively dividing, site possibly too dry). PUTNAM CO.: Eatonon Granite Outcrop, along shore of Oconee Lake, 135 m, 8.x.1999, W.R. Buck 36693 (NY). KENTUCKY. ESTILL CO.: Daniel Boone National Forest, 11.x.1995, R.C. Harris 37008 (NY, poor specimen without pycnidia). VIRGINIA. RICHMOND CITY: 42st Island, 6.vii.2008, on periodically submerged granite, B.P. Hodkinson 10208 (DUKE, NY). WEST VIRGINIA. TUCKER CO.: Blackwater Falls State Park, 23.iv.2001, W.R. Buck 39102 (NY).

- 12) *Xanthomendoza weberi* (S.Y. Kondratyuk & Kärnef.) L. Lindblom, Bryologist, 109(1): 5. 2006.

Oxneria weberi S.Y. Kondratyuk & Kärnef., Ukr. Botan. Journ., 60(2): 126. 2003. TYPE: U.S.A. TEXAS. GRIMES CO.: between Roans Prairie and Shiro, on Navasota-Huntsville Rd., 24.iv.1970, on *Quercus*, W.A. Weber s.n. = Lich. Exs. COLO no. 354 (KRAM-L[n.v.], holotype; NY!, isotype).

Syn. nov. *Xanthomendoza rosmarieae* S.Y. Kondratyuk & Kärnef. in Lumbsch et al., Phytotaxa, 18: 114. 2011. TYPE: U.S.A. DELAWARE. SUSSEX CO.: “Georgetown, northern entrance drive of Stockley Centre (on bark of aspen growing together with *Parmelia sulcata*), 1.iv.2000, Crichton 57” (ZT [not ZH!], holotype; NY!, isotype [see discussion below]).

Syn. nov. *Xanthoria wetmori* [sic] S.Y. Kondratyuk & Kärnef., Ukr. Botan. Journ., 60(2): 128. 2003. TYPE: U.S.A. IOWA. ALLAMAKEE CO.: Effigy Mounds National Monument, Hanging Rock, 11.vii.1996, *Quercus*, C.M. Wetmore 76328 (LD[n.v.] holotype; MIN!, isotype)

FIGURE 10 & 11 (PAGE 67 & 69).

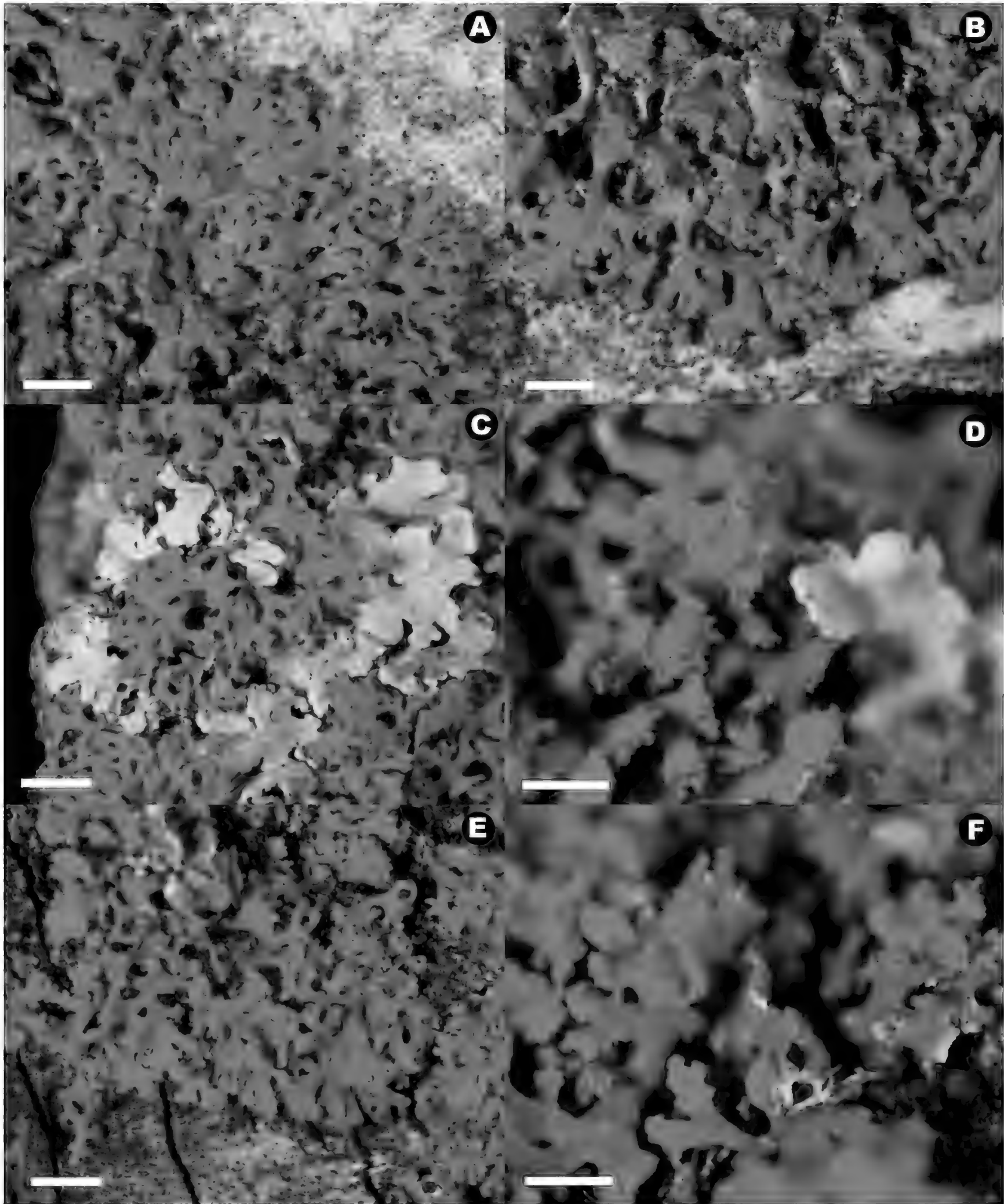


Figure 10, *Xanthomendoza weberi*. A & B, isotype of *Xanthoria wetmorei* (Wetmore 76328, MIN). C & D, thallus and apothecium from isotype of *Xanthomendoza weberi* (Weber s.n., NY). E & F, thallus and apothecia of *X. rosmarieae* (McAvoy s.n., NY). Scales = A-C, E: 1.0 mm; D and F: 0.5 mm.

DISCUSSION. – Recently, *Xanthomendoza rosmarieae* was described in Lumbsch et al. (2011) from a single collection made in Delaware, U.S.A. The type locality is situated in the Coastal Plain of southeastern North America, the region which is the center of distribution for *X. weberi* (see figure 11). *Xanthomendoza weberi* was segregated from *X. fulva* (Hoffm.) Söchting, Kärnef. and S.Y. Kondr. by Kondratyuk and Kärnefelt (2003). Although not directly linked to *X. fulva*, the protologue of *X. rosmarieae* stated that the new species differed from *X. weberi* which was previously included within *X. fulva*.

Since the authors of *Xanthomendoza rosmarieae* implied that it may represent a regional endemic we attempted to examine the only known collection in order to determine whether we might have additional material that had previously been misidentified as *X. weberi*. Unfortunately, the disposition of the type material is not possible to ascertain with certainty from the protologue, which stated only “holotype ZH, isotype K”. A search of Index Herbariorum (Thiers 2011) revealed no registered herbarium with the acronym “ZH” and that the lichens at K have mostly been transferred to BM. A query to the authors of the name received no reply and a loan request to BM (and subsequent correspondence with K) failed to turn up the relevant material. Since Rosmarie Honegger works in Zürich, Switzerland a loan request was also made to ZT to account for the possibility that “ZH” was a typographical error for “ZT”. The material was also not located at ZT. Since we were aware that the personal herbarium of Oliver Crichton, the collector of the type, had been deposited at DOV we attempted to locate a duplicate of the type collection in that herbarium. A search of DOV failed to locate any such specimen.

While attempting to locate the type material of *Xanthomendoza rosmarieae* in the herbaria mentioned above we also contacted several colleagues familiar with the type locality, a large mental health facility, one of whom visited the exact site where Crichton had obtained his material. The species was still present at the type locality, abundantly covering the trunks of planted Norway maples (*Acer platanoides* L., the tree Crichton apparently misinterpreted as “aspen”) along the roadside (W. McAvoy pers. comm.), and a robust fertile collection was obtained. As a last ditch effort to avoid the designation of a neotype we contacted Rosmarie Honegger with the hope that she still had the type material or had some knowledge of its deposition. We were elated when Honegger informed us the material was still housed in her laboratory and offered to send an isotype for inclusion in NY.

It should be noted that despite the problems cited above, the name *Xanthomendoza rosmarieae* was validly published because the authors both designated a holotype and indicated the herbarium it was deposited in. Had we not located the type material, after considerable effort, we would have been forced to determine the application of this name in the absence of a type. This situation highlights a significant gap in the current *ICBN*, which does not state whether names introduced with incorrect type specimen deposition information (be it due to orthographic error or not) are to be considered validly published. While extreme, the present case clearly illustrates the problems associated with attempting to determine the application of a name in the presence of erroneous type specimen deposition information.

Using the recent collection and the isotype discussed above we thus set out to determine how *Xanthomendoza rosmarieae* related to the other soresiate *Xanthomendoza* populations in eastern North America that we had previously referred to *X. weberi*. The authors of *X. rosmarieae* considered its distinguishing features to be “the presence of isidiate soresidia, rather wide and short rhizines, narrow ascospores, and a poorly developed true exciple of *textura intricata* type” (Kondratyuk & Kärnefelt in Lumbsch et al. 2011: 115). In comparing the taxon to members of the *X. weberi* group they specifically stated it differs as follows: 1) broader rhizines (“90-100 μm wide vs. 50-60 μm wide”), 2) lacking a strongly gelatinized pseudoprosoplectenchymatous true exciple (vs. the presence of that structure), and 3) a higher hymenium and narrower ascospores. We compared the isotype and topotype with an isotype of *X. weberi* as well as numerous additional herbarium specimens and the protologues of the two names. The results of this comparison can be summarized as follows.

First, the differences in rhizine width cited in the protologue are not supported by the description of *Xanthomendoza rosmarieae*, which provides a range (“0.05-0.06-0.12 mm”) that overlaps that of *X. weberi* (“40-60 μm ” *fide* Kondratyuk and Kärnefelt (2003)). Second, we believe that the differences in the proper (“true”) exciple cited by Lumbsch et al. (2011) are extremes of a continuum of variation in types of prosoplectenchymatous hyphal arrangement. The proper exciple of *X. rosmarieae* is thin and poorly developed, being composed of loosely aggregated *textura intricata*. While the proper exciple in the type material of *X. weberi* does differ in being strongly gelatinized and well developed, the hyphal arrangement is no different from that of *X. rosmarieae*.

The differences in the hymenium and ascospores cited in the protologue were also not supported by the material we examined. The protologue of *Xanthomendoza rosmarieae* states that the ascospores are

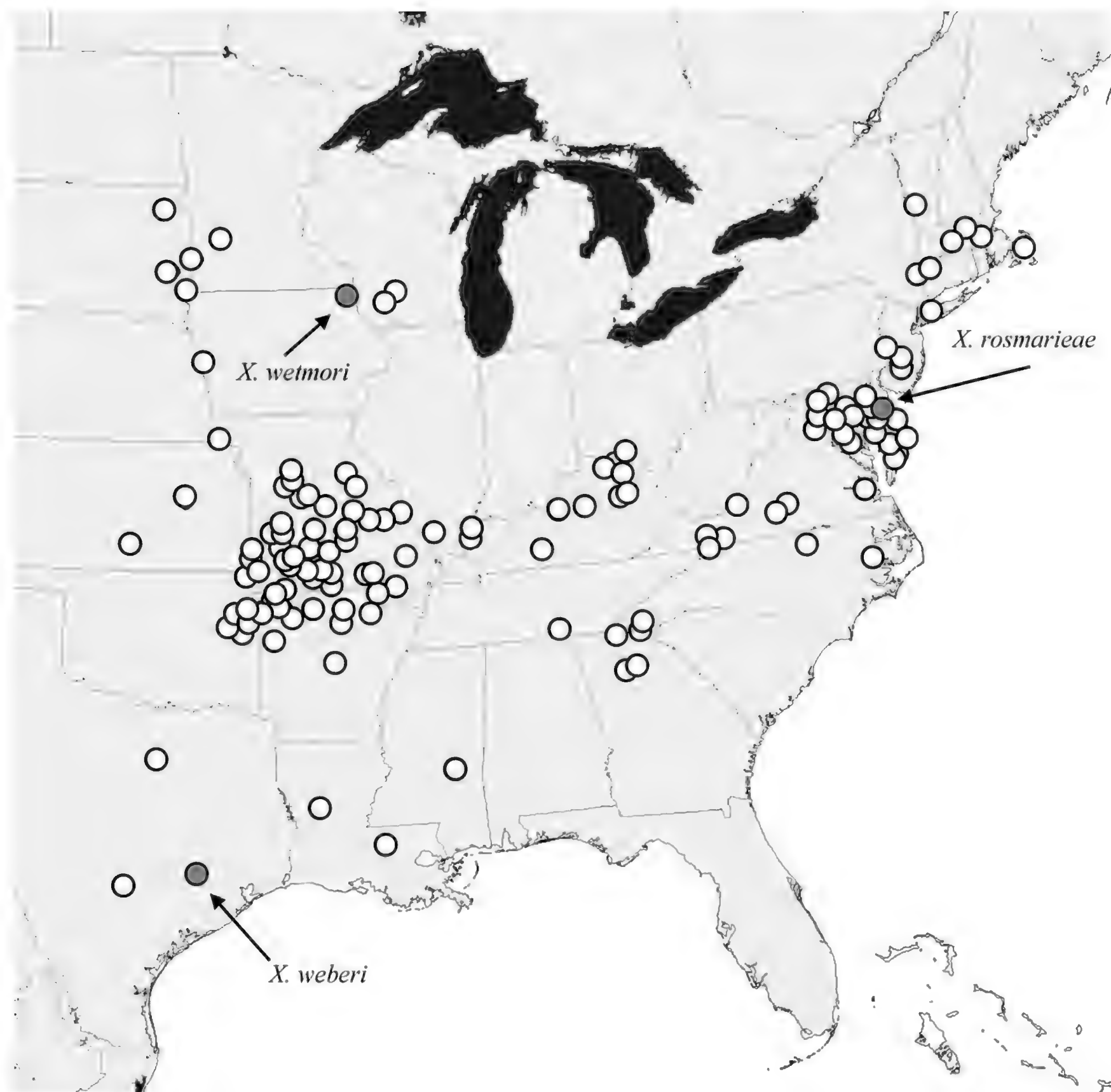


Figure 11. Geographic distribution of *Xanthomendoza weberi* based on 300+ specimens held at NY. Red circles denote type collections of *X. weberi* and the synonyms *X. rosmarieae* and *X. wetmorei*.

narrower than those of *X. weberi*, however we found them to be slightly wider (12.6-13.3 x 7.2-9.4 μm in *X. rosmarieae* vs. 8.4-13.2 x 4-7.3 μm in *X. weberi*). Even though our ranges were based on very small sample sizes ($n=4$ and $n=12$ respectively) overlap was observed. Neither protologue indicates how many measurements the published ranges were based on (“(8)10-16 x 6-8(-11) μm ” in *X. rosmarieae* vs “(12-)13-17(18) x (6-)9-10 μm ” in *X. weberi*) thus there is no way to evaluate their statistical robustness. Further, the differences between hymenial heights are equally elusive as the protologues cite ranges that abut but do not overlap (“70-90 μm ” in *X. rosmarieae* vs. “to 60 μm ” in *X. weberi*). However, the description of *X. weberi* does not provide a size range for the subhymenium whereas such data are presented for *X. rosmarieae*.

Regardless of the problems discussed above, one must question whether characters of the apothecia and ascospores should be used to distinguish sympatric sorediate species that are typically sterile. If apothecia and ascospores are required to identify a specimen, this would render the vast majority of collections impossible to determine. The only thallus characters cited by the authors to distinguish *Xanthomendoza rosmarieae* from its congeners were the width of the rhizines and the presence of “isidioid soredia”. As the differences in rhizine width do not appear to be significant the only remaining character is

the presence of “isidioid soredia”. In fact, neither the authentic material nor the illustrations accompanying the protologue show soredia that differ from those typically observed in *X. weberi*. In fact, the only such structures observed in the isotype of *X. rosmarieae* at NY were derived from admixed thalli of *Candelaria concolor* (Dicks.) Stein [!]. Considering the above we believe there are no significant differences separating *X. rosmarieae* and *X. weberi* and thus place them in synonymy here. This conclusion is further supported by the molecular phylogenetic analyses of Eichenberger et al. (2007) who found that sequences from the type collection of *X. rosmarieae* were not supported as distinct from those derived from other populations of *X. weberi*.

While researching the name *Xanthomendoza weberi* we also discovered the name *Xanthoria wetmorei* S.Y. Kondratyuk & Kärnef. published by Kondratyuk and Kärnefelt (2003) and typified by a collection from Iowa, U.S.A. Since the discussion in the protologue included references to *X. weberi* we decided to also attempt to determine the relationships of this taxon to *X. weberi/X. fulva*. The only distinguishing feature cited by the authors in the protologue of *X. wetmorei* was its much larger size relative to other species. No comparative measurements were provided however, and an examination of an isotype failed to find any significant differences from *X. weberi*. A conclusion that is further confirmed by analyses of nrITS sequence data from the holotype of *X. wetmorei* at LD (P. Fröden pers. comm.). Thus we also place *X. wetmorei* in synonymy with *X. weberi* here.

As was pointed out by Lindblom (2006) *Xanthomendoza gallowayi* (S.Y. Kondratyuk & Kärnef.) Söchting et al., may be an earlier name for *X. weberi*. Unfortunately at the time of her study Lindblom was unable to determine the correct application of that name because the type was unavailable for study from H. Subsequently, when discussing *X. rosmarieae*, the authors of that name referred to “*X. gallowayi* (syn. *X. weberi*)” (Lumbsch et al. 2011), implying that *X. weberi* is in fact a synonym of *X. gallowayi* as suspected by Lindblom (2006). Recently P. Fröden (pers. comm.) examined the type of *X. gallowayi*, which is still on loan to LD, and confirmed that it is not synonymous with *X. weberi*. This we continue to maintain the name *X. weberi* here.

Selected specimens examined (out of 280+). – **U.S.A. ARKANSAS.** BENTON CO.: Ozark National Forest, Wedington Wildlife Management Area, 12.iv.2004, on *Quercus*, R.C. Harris 48790 (NY). BOONE CO.: Crankelton Rd., ~1.5 mi N of Western Grove, 30.xii.2007, on *Quercus*, P. Majestyk 8033 (NY). CARROLL CO.: along US 62 just NE of the White River, 2.xi.2000, on dolomite, W.R. Buck 38730 (NY). FRANKLIN CO.: Ozark National Forest, summit of White Rock Mountain, 24.iv.1999, on *Quercus*, R.C. Harris 21438 (NY). IZARK CO.: NE corner of Devil’s Knob-Devil’s Backbone Natural Area, 24.x.2001, on dolomite, W.R. Buck 40330 (NY). JEFFERSON CO.: Pine Bluff Arsenal, 1.xii.1999, on *Quercus*, D. Ladd 21805 (NY). LAWRENCE CO.: Shirey Bay-Rainey Brake Wildlife Management Area, 29.iii.2006, on bark, W.R. Buck 50025 (NY). MARION CO.: CR 4029, ~2 mi W of US 235, 30.xii.2007, on *Quercus*, P. Majestyk 8128 (NY). NEWTON CO.: near town of Fallsville, vii.1954, on elms, M.E. Hale 3509 (NY). RANDOLPH CO.: Robert L. Hankins/Mud Creek Wildlife Management Area, 17.x.2003, on bark, C. Gueidan 996 (NY). **CONNECTICUT.** LITCHFIELD CO.: along CT 128 between Lake Waramaug and New Preston, sine date, sine coll. (NY). NEW HAVEN CO.: New Haven, 14.ii.1886, on bark, J.B. Hatcher s.n. (NY). **DELAWARE.** KENT CO.: 1 mi S of Leipsic, 3.vi.1962, on *Juglans*, C.F. Reed 63518 (NY). SUSSEX CO.: near Cool Spring, 15.ix.1962, on elms, C.F. Reed 58876 (NY). **GEORGIA.** BARROW CO.: Barnett Shoals Rd., 25.i.2002, on bark, R.J. Hill 1104 (NY). GWINNETT CO.: Dacula, 2885 Hog Mountain Rd., 2.vii.2004, on concrete, R.J. Hill s.n. (NY). TOWNS CO.: Reed Branch Wet Meadow TNC Preserve, 12.xi.2007, on *Nyssa*, J.C. Lendemer et al. 10364 (NY). **ILLINOIS.** COLES CO.: Lakeview Park, E of Charleston, 4.ix.1986, on *Quercus*, T. Motley 4 (NY). GALLETIN CO.: Immaculate Conception Cemetery, 21.iii.1994, on *Juniperus*, D. Ketzner 1641 (NY). HARDIN CO.: Rock State Park, 21.iii.1994, on *Juniperus*, D. Ketzner 1643 (NY). JACKSON CO.: Southern Illinois University, 15.ix.1991, on *Acer*, D. Ketzner 1391 (NY). LASALLE CO.: sine loc., 1906, on *Juglans*, W.W. Calkins 20 (NY). MONROE CO.: Fults Hill Prairie Nature Preserve, 7.xi.2004, on *Quercus*, R.C. Harris 50599 (NY). **INDIANA.** PUTNAM CO.: Greencastle, 18.iii.1909, on elm, H.J. Banker 1521 (NY). **IOWA.** LYON CO.: Gitchie Manitou State Preserve, 6.iv.2006, on quartzite, M.K. Advaita 5197 (NY). MONONA CO.: Loess Hills State Forest, 6.x.2006, on *Juniperus*, C.A. Morse 14202a (NY). PAGE CO.: T69N R38W Sec. 30S, 20.iv.1991, on elm, B. Wilson s.n. (NY). **KANSAS.** ANDERSON CO.: 1.5 mi S of Garnett, 12.vi.1950, on *Quercus*, O.S. Fearing 155 (NY). BUTLER CO.: Augusta, v.1954, on *Fraxinus*, M.E. Hale 2504 (NY). CHEROKEE CO.: Spring River Wildlife Area, 13.iv.2004, on *Quercus*, R.C. Harris 48886 (NY). COWLEY CO.: Cedar Vale, v.1954, on hackberry, M.E. Hale 2469 (NY). DOUGLAS CO.: Lone Star Lake, 20.ix.1950, on *Quercus*, O.S. Fearing 627 (NY). FRANKLIN CO.: 3 mi SW Ottawa, 2.viii.1949, on elm, R.L. McGregor 3607 (NY). LABETTE CO.: McCune, v.1954, on *Fraxinus*, M.E. Hale 2456 (NY). MIAMI CO.: Miami County State Park, 8.x.1950, on *Quercus*, O.S. Fearing 658 (NY). **KENTUCKY.** BATH CO.: Olympian Springs, 10.iv.1940, on trees, F.T. McFarland 566 (NY). BRECKENRIDGE CO.: Cloverport, 25.viii.1986, on elms, C.F. Reed 27234 (NY). JESSAMINE CO.: Nicholasville, 20.x.1941, on *Morus*, F.T. McFarland 149 (NY). MASON CO.: 4-5 mi W Maysville, 9.xi.1980, on bark, C.F. Reed 112715 (NY). METCALF CO.: Edmonton,

13.vii.1983, on trees, *C.F. Reed 117824* (NY). WOODFORD CO.: Versailles, 3.vi.1981, on bark, *C.F. Reed 113122* (NY). **LOUISIANA.** EAST BATON ROUGE PARISH: Baton Rouge, 7.vi.1975, on oaks and *Celtis*, *S.C. Tucker 14322* (NY). NATCHITOCHES CO.: Kisatchie National Forest, Longleaf Trail Vista, 27.iii.1982, on sandstone, *J. Pruski 2474* (NY). **MARYLAND.** CAROLINE CO.: Bethlehem, 30.v.1985, on *Acer*, *C.F. Reed 125017* (NY). CARROLL CO.: near Tyrone, 31.iii.1962, on rock, *C.F. Reed 54651* (NY). FREDERICK CO.: Jefferson, 17.vii.1986, on *Populus*, *C.F. Reed 127164* (NY). QUEEN ANNES CO.: Ruthsberg, 16.vii.1991, on *Acer*, *C.F. Reed 130858* (NY). TALBOT CO.: near Trappe Station, 24.iii.1962, *C.F. Reed 54575* (NY). WICOMICO CO.: 1 mi S of Upper Feery, 22.iv.1962, on *Juglans*, *C.F. Reed 56065* (NY). WORCESTER CO.: Milburn Landing, 23.ix.1981, on bark, *C.F. Reed s.n.* (NY). **MASSACHUSETTS.** BARNSTABLE CO.: Falmouth, 1860, on *Malus*, *J.L. Russell s.n.* (NY). MIDDLESEX CO.: Cambridge, *H. Edwards s.n.* (NY). NORFOLK CO.: Needham, 2.x.1909, on bark, *L.W. Riddle s.n.* (NY). WORCESTER CO.: Upton, 30.x.1956, on *Ulmus*, *B.N. Gates 1595* (NY). **MINNESOTA.** LESUEUR CO.: 3.5 mi SE of St. Peter, 23.iv.1983, on *Quercus*, *J.P. Schuster 344* (NY). LINCOLN CO.: TNC Hole in the Mountain Preserve, 18.v.2007, on *Quercus*, *M.K. Advaita 5802* (NY). YELLOW MEDICINE CO.: Upper Sioux Agency State Park, 5.x.2006, on *Quercus*, *C.A. Morse 14139A* (NY). **MISSISSIPPI.** JASPER CO.: Bienville National Forest, FSR 506-3, 30.ix.1992, on tombstone, *R.C. Harris 28852* (NY). **MISSOURI.** AUDRAIN CO.: Marshall I. Diggs Conservation Area, 13.iv.2005, on *Prunus*, *R.C. Harris 50616* (NY). COOPER CO.: Lamine River Conservation Area, 15.iv.2005, on *Gleditsia*, *R.C. Harris 50778* (NY). GASCONADE CO.: Canaan Conservation Area, 25.iii.2006, on *Juniperus*, *R.C. Harris 52034* (NY). LAWRENCE CO.: Fall Hollow Gorge, 27.iii.2006, on *Ulmus*, *R.C. Harris 52114* (NY). SALINE CO.: Marshall Junction Conservation Area, 14.iv.2005, on *Carya*, *R.C. Harris 50722* (NY). STONE CO.: Pilot Knob Conservation Area, 15.x.2005, on dolomite, *W.R. Buck 49490* (NY). WRIGHT CO.: John Alva Fuson M.D. Conservation Area, 4.xi.2002, on hardwood, *W.R. Buck 42825* (NY). **NEBRASKA.** RICHARDSON CO.: S of Rulo, 28.iii.1986, on bark, *W. Kiener 3520* (NY). **NEW JERSEY.** BURLINGTON CO.: Wharton State Forest, Hampton Furnace, 4.i.2004, on concrete, *J.C. Lendemer 1766* (NY). MONMOUTH CO.: 5 mi S Red Bank, sine date, *G.P. Anderson s.n.* (NY). **NEW YORK.** DUTCHESS CO.: Dover Plains, Roger Perry Preserve, 27.v.2007, on rock, *J.C. Lendemer 12309* (NY, fertile). SUFFOLK CO.: Long Island, Town of Southampton, 22.xi.1978, on bark, *R. Dirig L-2882* (NY). **NORTH CAROLINA.** BEAUFORT CO.: Leachville, 2.iv.1964, on bark, *C.F. Reed 138748* (NY). CLAY CO.: Nantahala National Forest, along Buck Creek Rd., 9.x.1998, on rock, *R.C. Harris 40685* (NY). ORANGE CO.: Chapel Hill, 17.vi.1936, on tree trunks, *J.H. Logan s.n.* (NY). **OHIO.** ADAMS CO.: Chaparral Prairie State Nature Preserve, 22.v.2006, on *Juniperus*, *J.C. Lendemer 7345* (NY). BUTLER CO.: Oxford, 1.vi.1951, *W.L. Culbertson 713* (NY). **OKLAHOMA.** CHEROKEE CO.: Cookson Wildlife Management Area, 14.iv.2004, on *Celtis*, *R.C. Harris 48974* (NY). MUSKOGEE CO.: Gruber Wildlife Management Area, 15.iv.2004, on *Ulmus*, *R.C. Harris 49054* (NY). OTTAWA CO.: Bicentennial State Park, 31.x.2000, on *Quercus*, *R.C. Harris 44407* (NY). **PENNSYLVANIA.** NORTHAMPTON CO.: Martins Creek, 15.ix.1990, on trees, *C.F. Reed 133582* (NY). **SOUTH DAKOTA.** DAY CO.: Enemy Swim Lake, 27.viii.2008, on hackberry, *M.K. Advaita 6807* (NY). LAKE CO.: Walker's Point Recreation Area, 28.v.2008, on *Populus*, *M.K. Advaita 6734* (NY). **TENNESSEE.** FRANKLIN CO.: Sewanee, 19.ii.2010, on *Ulmus*, *C. Parrish 53* (NY). **TEXAS.** TARRANT CO.: W of Fort Worth, 16.vi.1973, on *Prosopis*, *D. Griffin s.n.* (NY). TRAVIS CO.: Austin, 1934, on bark, *F. McAllister 58* (NY). **VIRGINIA.** ACCOMAC CO.: between Oak Hill and New Church, vi.1936, on bark, *G.P. Anderson s.n.* (NY). APPOMATTOX CO.: N of Appomattox, 28.x.1962, on *Robinia*, *C.F. Reed 59096* (NY). FARQUIER CO.: VA 601 at the Plains, 26.iv.1997, on tree, *J. Guccion 1082* (NY). LOUDOUN CO.: Middleburg, 17.vi.1978, on tombstones, *B. Allen 1044* (NY). NORFOLK CO.: near Fentress, 16.iv.1963, on bark, *C.F. Reed 61614* (NY). WASHINGTON CO.: 3 mi W of Whitetop Mt., 30.xi.1969, on trees, *C.F. Reed 84368* (NY). **WISCONSIN.** RICHLAND CO.: 2 mi S of Ithaca, 23.vi.1974, on bark, *M. Nee 12305* (NY). SAUK CO.: Baraboo Hills, 4.ix.1998, on *Quercus*, *R.C. Harris 42215* (NY).

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LITERATURE CITED

- Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven, London. 795 pp.
- Clauzade, G., C. Roux and R. Rieux, 1981[1982]. Les *Acarospora* de l'Europe occidentale et de la region méditerranéenne. Bulletin du Musé d'Histoire Naturelle de Marseille, 41: 41–93.
- Culberson, C.F. and H. Kristinsson. 1970. A standardized method for the identification of lichen products. Journal of Chromatography, 46: 85–93.
- Egea, J.M. and P. Torrente. 1993. The lichen genus *Bactrospora*. The Lichenologist, 25: 211–255.
- Eichenberger, C., S. Scherrer and R. Honegger. 2007. Chapter III: A multilocus approach to the phylogeny of representatives of the genera *Xanthoria* and *Xanthomendoza* (Teloschistaceae, Lichen-Forming Ascomycetes). In: Eichenberger, C. Molecular Phylogenies of Representatives of *Xanthoria* and *Xanthomendoza* (Lichen-Forming Ascomycetes). [Dissertation]. Zürich. 30–55pp.
- Ekman, S. 1996. The corticolous and lignicolous species of *Bacidia* and *Bacidina* in North America. Opera Botanica, 127: 1–148.
- Esslinger, T.L. 2010. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: <http://www.ndsu.edu/pubweb/~esslinge/chcklst/chcklst7.htm> (First Posted 1 December 1997, Most Recent Version (#16) 18 June 2010), Fargo, North Dakota.
- Harris, R.C. and D. Ladd. 2005. Preliminary draft: Ozark lichens; Enumerating the lichens of the Ozark Highlands of Arkansas, Kansas, Illinois, Missouri, and Oklahoma: Prepared for the 14th Tuckerman Lichen Workshop, Eureka Springs, Arkansas. 249pp. [Available for download at http://sweetgum.nybg.org/ozarklichens/biblio_detail.php?irn=132967]
- James, P.W. and A. Vězda. 1971. *Melanophloea* P. James & Vezda, a new lichen genus. The Lichenologist, 5: 89–91.
- Knudsen, K. 2006. *Acarospora obpallens* (Nyl. ex Hasse) Zahlbr. in the southeastern United States. Evansia, 23: 9–10.
- Knudsen, K. 2007[2008]. *Acarospora*. In T.H. Nash III, C. Gries and F. Bungartz (eds.). Lichen Flora of the Greater Sonoran Desert Region, vol. 3: 1–38. Lichens Unlimited, Tempe, AZ.
- Knudsen, K. 2008. *Acarospora fuscescens* (Acarosporaceae), a little known species of western North America. Evansia, 25: 82–84.
- Knudsen, K. 2011. *Acarospora nashii*, a lichenicolous lichen from western North America. In Bates, S. et. al. Biomonitoring, Ecology, and Systematics of Lichens. Bibliotheca Lichenologica, 106: 169–172.
- Knudsen, K., J.A. Elix and V. Reeb. 2008. A preliminary study of the genera *Acarospora* and *Pleopsidium* in South America. Opuscula Philolichenum, 5: 1–22.
- Knudsen, K. and J. Kocourková. 2009. A taxonomic study of *Polysporina gyrocarpa* and *P. cyclocarpa* (Acarosporaceae) and a new record from Asia of *P. arenacea*. In A. Thell, M.R.D. Seaward & T. Feuerer (eds). Diversity of Lichenology – Jubilee Volume. Bibliotheca Lichenologica, 100: 199–206.
- Knudsen, K. and C. Morse. 2009. *Acarospora nicolai* (Acarosporaceae), a rediscovered species. The Bryologist, 112: 147–151.
- Knudsen, K., V. Reeb, M. Westberg, R. Srikantha and D. Bhattacharya. 2010. *Acarospora rosulata* in Europe, North America and Asia. The Lichenologist, 42: 291–296.
- Knudsen, K. and S.M. Standley. 2007. *Sarcogyne*. In T.H. Nash, III, C. Gries and F. Bungartz. Lichen Flora of the Greater Sonoran Desert Region. Volume 3. Lichens Unlimited, Arizona State University, Tempe, pp. 289–296.
- Kocourková-Horáková, J. 1998. Distribution and Ecology of the genus *Thelocarpon* (Lecanorales, Thelocarpaceae) in the Czech Republic. Czech Mycology, 50: 271–302.
- Kondratyuk, S.Y. and I. Kärnefelt. 2003. Five new Xanthorias from Holarctic. Ukrayins'kyi Botanichnyi Zhurnal, 60: 121–130.
- Lendemer, J.C. 2010. Contributions to the lichen flora of Pennsylvania: further new and interesting reports of lichens and lichenicolous fungi. Evansia, 27: 47–64.
- Lendemer, J.C. and K. Knudsen. 2011. Studies in lichens and lichenicolous fungi: no. 7, more notes on taxa from North America. Mycotaxon 115.
- Lindblom, L. 2006. *Xanthomendoza galericulata*, a new sorediate lichen species, with notes on similar species in North America. The Bryologist, 109: 1–8.
- Lumbsch, H.T. and R. Guderley. 1997. *Lecanora vacillans* H. Magn., a remarkable species and its taxonomic significance. The Lichenologist, 29: 29–34.
- Lumbsch, H.T., M. Plümper, R. Guderley and G.B. Feige. 1997. The corticolous species of *Lecanora* sensu stricto with pruinose apothecial discs. In: Tibell, L. and I. Hedberg (eds.): Lichen Studies Dedicated to Rolf Santesson. Symbolae Botanicae Upsalienses, Acta Universitatis Upsaliensis, Uppsala, pp. 131–161.
- Lumbsch, H.T., D.G. Zimmermann and I. Schmitt. 2009. Phylogenetic position of ephemeral lichens in Thelocarpaceae and Vezdaeaceae (Ascomycota). In A. Thell, M. R. D. Seaward and T. Feuerer: *Diversity of Lichenology Anniversary Volume*. Bibliotheca Lichenologica, 100: 389–398.
- Lumbsch, H.T. [+103 authors not cited here]. 2011. One hundred new species of lichenized fungi: a signature of undiscovered global diversity. Phytotaxa, 18: 1–127.

- McCarthy, P.M. 2008: A new species of *Melanophloea* (Thelocarpaceae) from north-eastern Queensland. *Australasian Lichenology*, 62: 26–28.
- McCarthy, P.M. and G. Kantvilas. 2009. Thelocarpaceae. In P.M. McCarthy: *Flora of Australia* Volume 57. Lichens 5. ABRS and CSIRO Publishing, Canberra and Melbourne. xx + 687 pages, pp. 563–569.
- Magnusson, A.H. 1929. A monograph of the genus *Acarospora*. *Kungliga Svenska Vetenskapsakademiens Handlingar*, ser. 3, 7: 1–400.
- Magnusson A.H. 1930. The Lichen Genus *Acarospora* in New Mexico. *Meddelelser fran Göteborgs Botaniska Trädgård*, 5: 55–72.
- Magnusson, A.H. 1933. Supplement to the Monograph of the genus *Acarospora*. *Annales de Cryptogamie Exotique*, 6: 13–48.
- McCune, B. and R. Rosentreter. 2007. Biotic Soil Crust Lichens of the Columbia Basin. *Monographs in North American Lichenology*. Volume 1. Northwest Lichenologists, Ltd., Corvallis. 105 pp.
- Moon, K.H. and A. Aptroot. 2009. Pyrenocarpous lichens in Korea. In A. Aptroot, M. R. D. Seaward and L. B. Sparrius: *Biodiversity and Ecology of Lichens*. *Liber Amicorum Harrie Sipman*. *Bibliotheca Lichenologica*, 99: 297–314
- Salisbury, G. 1996. A Monograph of the lichen genus *Thelocarpon* Nyl. *The Lichenologist*, 3: 175–196.
- Thiers, B. 2011[continuously updated]. Index Herbariorum: A global directory of public herbaria and associated staff. New York Botanical Garden's Virtual Herbarium. <http://sweetgum.nybg.org/ih/>
- Thomson, J.W. 1997. *American Arctic Lichens*. 2. The Microlichens. The University of Wisconsin Press, Madison. 675 pp.
- Willey, H. 1890. A synopsis of the genus *Arthonia*. New Bedford. 62pp.

APPENDIX 1 - A KEY TO THE ACAROSPORA SPECIES WITH LECANORIC/GYROPHORIC ACID IN NORTH AMERICA

1. Thallus yellow2
 2. Thallus effigurate; medulla **and** cortex C+ red*A. erythrophora*
 2. Thallus not effigurate; only cortex **or** medulla C+ red3
 3. Cortex C+ red; medulla C-; thallus areolate, coastal California and Baja.....*A. robiniae*
 3. Cortex C-; medulla C + red; thallus areolate or squamulose; southern North America.....*A. tuckerae*
1. Thallus brown or white (i.e., with pruina).....4
 4. Algal layer interrupted by hyphal bundles, uneven to jagged.....5
 5. Spores narrowly ellipsoid, without a mucilage sheath; thallus epruinose, lichenicolous.....*A. succedens*
 5. Spores broadly ellipsoid, with distinct mucilage sheath; thallus polymorphic, usually pruinose, not lichenicolous.....*A. nevadensis*
 4. Algal layer continuous and not interrupted, sometimes thin.....6
 6. Areoles usually reduced to a thalline margin, mostly round with single apothecium.....7
 7. Areole pitted (faveolate) especially around the apothecia, sometimes pruinose.....*A. obpallens*
 7. Areole not pitted (faveolate), not pruinose.....*A. janae*
 6. Areoles or squamules usually not reduced to a thalline margin, not mostly round with single apothecium.....8
 8. Thallus usually forming a rimose-areolate crust, usually yellow-brown and dull, often lobulate, lower surface black, common.....*A. fuscata*
 8. Thallus not forming a rimose-areolate crust, various brown hues, dull or glossy, lobulate or not, lower surface black or not, frequent or rare.....9
 9. Thallus squamulose; squamules with a stipe; lower surface black.....*A. thamnina*
 9. Thallus not squamulose; areoles without a stipe; lower surface not black.....10
 10. Areoles pruinose; thallus not effigurate.....*A. nicolai*
 10. Areoles not pruinose; thallus effigurate or not.....11
 11. Thallus effigurate.....12
 12. Apothecia conspicuous (to 1 mm.).....*A. rosulata*
 12. Apothecia inconspicuous (to 0.3 mm).....*A. complanata*
 11. Thallus not effigurate.....13
 13. Areoles becoming subsquamulose; apothecia with epihymenial plectenchyma.....*A. peliscypha* s. lat.

13. Areoles not becoming subsquamulose; apothecia without epihymenial plectenchyma.....*A. fuscescens*

Notes on species included in the key

Acarospora complanata H. Magn. – For a description see Magnusson (1929). For more information and an illustration see Lendemer and Knudsen (2011). This species is in need of revision in Europe after Clauzade et. al. (1981) made the species concept heterogeneous. The two American specimens of this taxon need further study and may represent a species new to science.

Acarospora erythrophora H. Magn. – For a description see Knudsen (2007).

Acarospora fuscata (Schr.) Th. Fr. – For a description and illustration see Knudsen (2007). Specimens from eastern North America are often profusely lobulate but always broadly attached.

Acarospora fuscescens H. Magn. – For a description and illustration see Knudsen (2008). This interesting species occurs on sandstone and soil in western North America. It usually forms an exclusive crust, excluding other lichens. Though most apothecia are punctiform, rarely the disc dilates.

Acarospora janae K. Knudsen – For a minimal description and illustration see Lumbsch et. al. (2011). Further notes and extensive illustrations are provided herein.

Acarospora nevadensis H. Magn. – For a description see Knudsen (2007). Most specimens look like *A. strigata* (Nyl.) Jatta and have broad ascospores similar to those that species. But the spores of *A. nevadensis* are shorter and have a distinct mucilage sheath. Apparently this species is rare, but it is likely often misidentified because spot tests are not performed. Only a few epruinose populations were seen from Arizona, U.S.A..

Acarospora nicolai B. de Lesd. – For a description and illustration see Knudsen and Morse (2009).

Acarospora obpallens (Nyl. ex Hasse) Zahlbr. – For a description and illustration see Knudsen (2007).

Acarospora peliscypha Th. Fr. – For a description of this species see Knudsen (2007). North American populations are in need of a revision following the revision of the “rugulosa/bullata” in Europe (Knudsen et al. 2010). At this time we do not recognize *Acarospora rugulosa* Körb. (Thomson 1997; Esslinger 2010) which is probably the earliest name for *A. bullata* Anzi, a species that does not occur in North America (Knudsen et al. 2010).

Acarospora robiniae K. Knudsen – For a description and illustration see Knudsen (2007). This is a coastal species from Baja California in Mexico to central California, U.S.A. Currently the most northernmost collection known is from top of Morro Rock, in Morro Bay, San Luis Obispo Co., California (UCR).

Acarospora rosulata H. Magn. – For a description and illustration see Knudsen et al. (2010). Previously North American populations were misidentified as *A. bullata* Anzi (Magnusson 1929; Knudsen 2007).

Acarospora succedens H. Magn. – This is an older name for *A. interspersa* H. Magn. (Knudsen 2011). For a description see Knudsen (2007) under *A. interspersa*. It is no longer recognized as occurring in California. The species described as *A. succedens* in Knudsen (2007) is now called *A. nashii* K. Knudsen (Knudsen 2011).

Acarospora thamnina (Tuck.) Herre – For a description and illustration see Knudsen (2007). This species is common in western North America. It has probably been misidentified in Alaskan and Canadian collections as *A. fuscata*, and is rare in eastern North America. In moist conditions this species can be quite lobulate and look like *A. fuscata*, but it usually has a well-developed stipe.

Acarospora tuckerae K. Knudsen – For description see Knudsen (2007). For an illustration and more distributional data see Lendemer (2010). The unpublished name *A. rubescens* R.C. Harris & Ladd ined. applies to this taxon (Harris & Ladd 2005)

Names for *Acarospora* species with gyrophoric/lecanoric acid excluded from the North America lichen flora

Acarospora rugulosa Körb. – See note for *A. peliscypha* above.

Acarospora sparsa H. Magn. – This species was based on a single specimen in the herbarium of Bouly de Lesdain, which was presumably lost during World War II (Magnusson 1933). Based on the description, this appears either to be the third time Magnusson described *A. nicolai* B. de Lesd.

(Knudsen & Morse 2009) or he is describing a morph of *A. obpallens* or *A. janae*. Unfortunately the description is inadequate to allow for the selection of a neotype.

Acarospora tongleti Hue – see note *A. variegata* below.

Acarospora variegata H. Magn. – This is a European species which needs a new revision. Magnusson reported it from North America based on a specimen in the herbarium of Bouly de Lesdain, which was lost during World War II (Magnusson 1929). It is currently treated as a synonym of *A. tongleti* Hue on the North American checklist (Esslinger 2010), a species described from Belgium. The first author does not know the source of this synonymy nor does he accept it. Neither *A. variegata* nor *A. tongleti* are recognized as occurring in North America.

A Preliminary Study of *Pleopsidium stenosporum* (Stizenb. ex Hasse) K. Knudsen

KERRY KNUDSEN¹

ABSTRACT. – *Lecanora stenospora* is revised and transferred to *Pleopsidium*. It is known from California and Washington in western North America. The thallus morphology of the species is intermediate between *P. discurrens* from Tibet and *P. flavum* which also occurs in North America. It occurs on limestone, mafic greenstone, and probably other slightly calcareous metamorphic rocks. No collections were seen on granite, a common substrate of *P. flavum*.

KEYWORDS. – Cascade Mountains, H.E. Hasse, Kettle Mountains, Okanogan Highlands, morphology, San Gabriel Mountains.

INTRODUCTION

During the writing of the *Acarospora* A. Massal. treatment for the *Lichen Flora of the Greater Sonoran Desert Region* (Knudsen 2007a), I saw a specimen of *Lecanora stenospora* Stizenb. ex Hasse from the San Gabriel Mountains in southern California (FH!). The small dispersed yellow areoles were round and convex to elongated and angular and it looked like a yellow *Acarospora* with unusual thallus morphology. The specimen was sterile. Shortly before his death, Bruce Ryan told me he had found one fertile apothecium on the specimen and it was an *Acarospora*. I assumed it might be some strange depauperate form of *A. socialis* H. Magn. or *A. novomexicana* H. Magn. It did not look like *Pleopsidium flavum* (Bellardi) Körb., the common species in North America. During my recent visits to the Farlow Herbarium I looked for the type specimen I had seen earlier but did not find it. Fortunately Frank Bungartz photographed it (fig. 1A).

Ernie Brodo sent me an image of a strange *Acarospora* or *Pleopsidium* taken by Rob Schlingman, an engineer, while hiking on Mount Herman at 6000 feet in the Mount Baker Backcountry in the northern Cascades in Washington (fig. 1B). I remembered *L. stenospora* and ordered the holotype from Zurich (ZT) where the Stizenberger herbarium is housed. A. H. Magnusson (1929: 377) wrote: “An (authentic?) specimen in herb. Stizenberger, Zürich, is a *Lecanora*-species (sect. *Placodium*) or *Lecania* with probably eight spores, 14-17 x 4.5-5.5 µm large, usually one-septate.” I received two packets from ZT, one of which was empty, and the other contained a brown *Lecania* species on soil. The protologue is quite clear that the type is a yellow *Acarospora*. Based on the Hasse specimen I had seen from FH, I believe the holotype is the missing specimen. (The *Lecania* will be studied separately but is not an authentic specimen and is mislabeled.) Magnusson also saw a sterile type specimen in Zahlbruckner’s herbarium (W), thought it was similar to *Pleopsidium flavum*, and treated it among the taxa he excluded from *Acarospora* (Magnusson 1929).

Recently when visiting the United States National Herbarium (US), I looked for possible specimens of *Lecanora stenospora*, but did not find any. But I was excited when I found two of H.E. Hasse’s collections of *L. stenospora* at the New York Botanical Garden (NY), which received part of his herbarium in 1906 (Knudsen 2010). Both had some fertile areoles so I was able to identify the taxon to genus (figs. 2B & D). Remembering Rob Schlingman’s picture, I searched through the undetermined yellow *Acarospora* at NY and found a good specimen from Washington on a hard limestone of unknown type (figs. 2A, C, and E).

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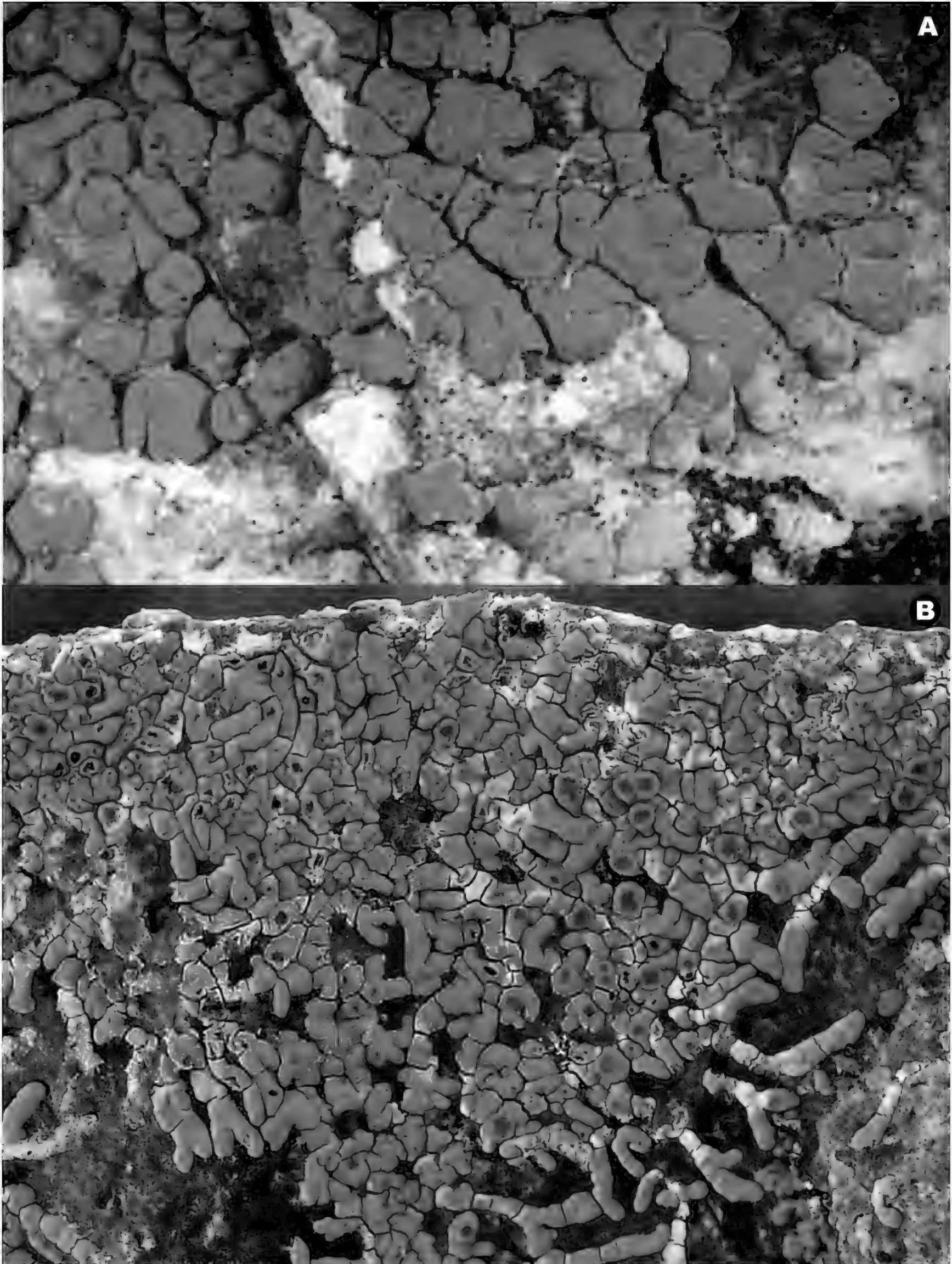


Figure 1, *Pleopsidium stenosporum*. **A**, photograph of missing type specimen from FH taken by Frank Bungartz. **B**, photograph of *P. stenosporum* in the field in Washington, U.S.A. taken by Rob Schlingman. Scales for both images not known.

This is a preliminary investigation of *Lecanora stenospora*. Only the protologue by Hasse is quoted in the description. The species is discussed based on specimens and photographs. It is transferred to *Pleopsidium* and compared to the other four species in the genus. The probable ecology, especially its substrate preferences, and distribution are discussed. A neotype is designated but it is a poor specimen. Later, when more specimens are discovered, the species will be completely revised, a process already begun as this paper was out for review. If it is a good species, a well-developed epitype can be selected from a modern collection.

MATERIALS AND METHODS

Specimens from ZT, NY, and UCR were studied as well as photographs by Frank Bungartz and Rob Schlingman. Hand sections of specimens were examined using standard microscopy in water and KOH. Measurements were made in water. Ascus structure was studied in I and K/I. Rock was tested with HCl.

THE SPECIES

Pleopsidium stenosporum (Stizenb. ex Hasse) K. Knudsen comb. nov.

Mycobank #561531.

FIGURES 1 & 2 (PAGES 78 & 81).

Basionym. *Lecanora stenospora* Stizenb. ex Hasse, Bull. Torrey Bot. Club, 24: 447. 1897. TYPE: **U.S.A. CALIFORNIA.** [LOS ANGELES or SAN BERNARDINO CO.:] San Gabriel Mountains, 1800 m upward, vi.1894, on rock, *H.E. Hasse s.n.* (ZT!, holotype **lost and presumed destroyed**). NEOTYPE: same locality data as the type, above 800 m, on unknown rock type with some HCl+ inclusions, 1895, *H.E. Hasse s.n.* (NY! [Hasse Herb. No. 368²], neotype **designated here**).

Acarospora stenospora (Stizenb. ex Hasse) Hue, Nouv. Arch. Mus. Hist. Nat. Paris, 1: 161. 1909.

Acarospora stenospora (Stizenb. ex Hasse) Zahlbr. *nom. illeg. superf.*, Cat. Lich. Univ., 5: 108. 1928.

DESCRIPTION (REPRODUCED FROM HASSE 1897). – “Thallus cartilaginous, in the center of separate rounded or approximate, then angular convex squamules; those at the circumference extending in to short broad contiguous rounded lobules, citrine yellow; apothecia small, depressed, becoming flat and superficial, immarginate; spores minute and numerous; paraphyses short, thick, adglutinated. Similar to *L. chlorophanum* Tuck. [sic], but this has a thalline margin and long slender septated paraphyses.”

ECOLOGY AND DISTRIBUTION. – The species is currently only known from western North America. It occurs on hard limestone, mafic greenstone, an unknown metamorphic rock with HCl+ inclusions, and quartzite with mineral inclusions. The three areas where it was collected host a rich diversity of rock types due to tectonic activity along the edge of the North American Plate. In the Pacific Northwest in Washington it is known from two locations. It occurs on mafic Mount Herman greenstone in the northern Cascade Mountains on Mount Herman at 6000 feet in the Mt. Baker Backcountry (Haugerud 1995). In the Okanogan Highlands, in the northeastern part of the state, it occurs on a hard limestone of unknown type in the Kettle Range, which is the western most extension of the Rockies. In southern California it is only known from the San Gabriel Mountains, probably from the San Antonio Canyon area (see discussion below). The dominant rock of the San Gabriel Mountains is granite. The two collections I studied are not on granite, but an unknown metamorphic rock with HCl+ mineral inclusions. The rock of the FH specimen is a quartzite with mineral inclusions, but not tested with HCl. Unfortunately the labels lack information on whether specimens were collected in full sun or extreme shaded overhangs and other important ecological or geological data.

DISCUSSION. – On the scant neotype (figs. 2B, D, & F) and a second scant Hasse specimen at NY, the round convex areoles were broadly attached (not squamules), dispersed in a un-oriented pattern, and

² No. 368 is Hasse’s herbarium number for *Lecanora stenospora* (for explanation see Knudsen 2010). Hasse’s labels usually have poor location data. His elevations are considered estimates.

apparently less glossy and thicker than the areoles of *Pleopsidium flavum*. Elongated angular areoles were lacking, though beginning to form. Most areoles were ca. 2 mm in diameter or less. A few apothecia were found, immersed in the small areoles, 0.1-0.3 mm in diameter, yellow to dull yellow-red in color. The hymenium was 60-100 μm tall, the paraphyses were slender (2 μm) and septate. The ascus was *Pleopsidium*-type (Hafellner 1993). Mature ascospores were not seen. Conidia were simple and hyaline, mostly 2 x 1 μm . Both specimens produced rhizocarpic acid (Kathleen Sayce, TLC performed in 1980) and spot tests were K- and KC-. In the photograph by Frank Bungartz of the sterile FH specimen collected by Hasse, *Lecanora stenospora* has an un-oriented, dispersed thallus with long angular areoles (one seen forking) in addition to the round areoles and does not occur on granite but on mineral-rich quartzite that was not tested with HCl. The specimen from Mt. Herman in Washington photographed by Rob Schlingman has small superficial apothecia with a thalline margin and has a similar thallus of round areoles and elongated angular areoles in a dispersed un-oriented pattern (fig. 1B). The specimen from the Kettle Range in Washington on limestone has a similar scattered thallus that matches that of the type collection, but with fewer angular areoles. The superficial apothecia are always smaller than the apothecia of *P. flavum* (<0.6 mm vs. mostly 0.5-1.0 mm in diameter). They begin immersed in the thallus, visible as small spots that are more yellow than the thallus. Few ascospores were found outside the asci but the spore range appears to be (3-)4-5 x (1.5-)2.0 μm when mature. Based on the ascus type, *L. stenospora* is transferred to *Pleopsidium* (Hafellner 1993).

Based on the preliminary observations presented here, *Pleopsidium stenosporum* does not differ significantly in its micromorphology from *P. flavum* or *P. chlorophanum* (Wahlenb.) Zopf, both of which occur in southern California (Knudsen 2007b), or from *P. discurrens* (Zahlbr.) Obermayer from Tibet (Obermayer 1996). *Pleopsidium gobiense* (H. Magn.) Hafellner from Mongolia also has a similar micromorphology but has broader ascospores than *P. stenosporum* (4.5-5.5 x 2-3.5 μm) (Magnusson 1929, Hafellner 1993, Obermayer 1996). *Pleopsidium gobiense* also lacks the pair of fatty acids, acaranoic acid and acarenoic acid, that are common in the genus (Obermayer, pers. comm.)

All four species of *Pleopsidium* are easily distinguished by their rather uniform gestalts. *Pleopsidium chlorophanum* has an aggregated thallus with broad lobes, becoming squamulose, with large convex apothecia up to 2.5 mm in diameter with a constricted base in the center of the thallus (Knudsen 2007b; for an image see the back cover of the Bulletin of California Lichen Society http://californialichens.org/bulletin/cals12_1.pdf). *Pleopsidium flavum* has a thin densely aggregated thallus (areoles not dispersed) with an effigurate margin with short lobes, apothecia which are never strongly convex and less than 1 mm in diameter, and is common in Asia, Mediterranean Europe and North America (Magnusson 1929, Obermayer 1996). See Knudsen (2007b) for a description and illustration of *P. flavum* or Brodo et al. (2001) for an illustration (note that in that reference the species concepts are incorrect[!]; also http://www.sharnoffphotos.com/lichensF/pleopsidium_chlorophanum.html has two images of *P. flavum* misidentified as *P. chlorophanum*, one a Sierra Nevada morphotype discussed below). *Pleopsidium gobiense* also has an effigurate thallus with uneven areoles with immersed apothecia in the densely aggregated center of the thallus and is restricted to Asia with its center of distribution in the Gobi Desert of Mongolia (Magnusson 1929, Hafellner 1993, Obermayer 1996). *Pleopsidium discurrens* has a beautiful thallus of long lines of elongate areoles, sometimes in a radial pattern, with sessile apothecia with thalline margins (Obermayer 1996; download paper with images at <http://www.uni-graz.at/~oberma/pleopsidium-discurrens-obermayer-1996.pdf>.) As is illustrated here, the gestalt of *P. stenospora* differs from all the above in having an un-oriented and dispersed thallus of round to elongate and angular areoles with apothecia both immersed and superficial with a thalline margin, all 0.5 mm or less in diameter. Its thallus morphology is intermediate between *P. discurrens* and *P. flavum*. Macromorphological variation between specimens of *P. stenospora* depends on the ratio of round to angular areoles. This thallus pattern, especially when angular areoles predominate (fig. 1), is what Hasse meant when he described the thallus as “cartilaginous” (Hasse 1897). To Hasse, a surgeon, the thallus looked “skeletal” in its articulation. Based on its distinct thallus morphology, *P. stenosporum* is tentatively recognized as the fifth species in the genus.

Pleopsidium stenosporum contains rhizocarpic acid, according to TLC data annotated on both specimens. Further investigation of the chemistry of *P. stenosporum* will be carried out in the future by Markéta Michalová under the supervision of Jana Kocourková and Martin Kukwa, during her study of the chemistry of Mojave Desert lichens including *P. flavum*. Possible substances that may also be present in *P. stenosporum* include acaranoic, acarenoic, tectronic, and lichesterinic acids (Hafellner 1993, Obermayer 1996). Walter Obermayer studied specimens of *P. flavum* from MIN and found that they had either

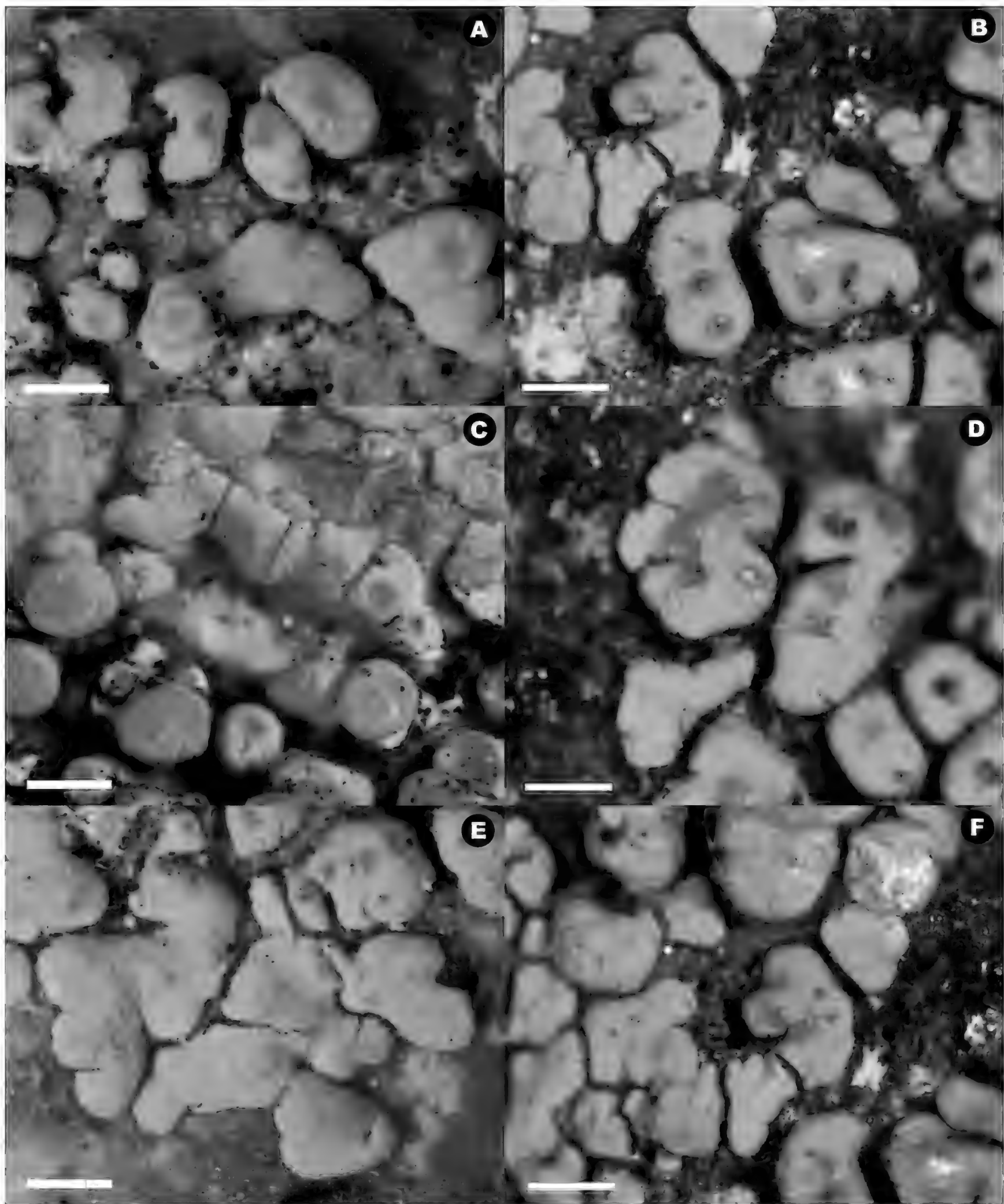


Figure 2, *Pleopsidium stenosporum*, variable development of fertile and infertile areoles in un-oriented pattern. **A, C, and E** are from *Foster 2320* (NY), scales = 0.5 mm. **B, D, and F** are from *Hasse 368* (NY, neotype), scales = 0.5 mm.

acaranoic and acarenoic acids or angardianic/roccellic acid and its satellites (Obermayer, *pers. comm.*). Fatty acids may be a distinguishing character between *P. stenosporum* and *P. flavum*.

Pleopsidium flavum is common in the mountains of southern California on granite, gneiss, and basalt (Cuyamaca Peak, Lost Horse Mountains, Malapai Hill, Santa Ana Mountains, San Bernardino Mountains and San Jacinto Mountains *fide* UCR (2011)) and Hasse collected it in the San Gabriel Mountains on granite (NY!). Initially I wondered why I have not collected *P. stenosporum*. Due to the exigencies of contracts and grants, I have done very little collecting in the San Gabriel Mountains. I wondered if *P. stenosporum* is restricted to the San Gabriel Mountains because it prefers a particular rock type. Serpentine and greenstone are unknown from the range. Limestone is rare in southern California and can look similar to the rock type from the Kettle Range. A type of limestone is present in the eastern San Gabriel Mountains in Cascade Canyon, a branch of San Antonio Canyon, where it occurs in alternating layers with quartzite and gneiss at an elevation of 1371 m (ca. 4500 feet) to 1524 m (ca. 5000 feet). The canyon also has diverse metamorphic rock types and 20 reported minerals (Mindat.org 2011). Hasse may have collected *P. stenosporum* in Cascade Canyon. He often collected in San Antonio Canyon and would have been able to easily access Cascade Canyon on mining roads. A permit is currently being processed by the National Forest Service. In the coming year I plan to search for populations of *P. stenosporum* in San Gabriel Mountains, beginning in Cascade Canyon, with the help of the botanist Kerry Myers.

The Cascade Mountains, which stretch from Northern California to British Columbia, are an active continental volcanic arc where the Pacific Plate is being subducted beneath the North American Plate. While volcanic rock predominates, the range contains terranes of limestone, greenstones, and serpentine, as well as many other metamorphic rock types, scattered through the complex Northern Cascades (Geology of Washington 2011). This is where Rob Schlingman photographed *Pleopsidium stenospora*. I would expect more populations of *P. stenosporum* to be discovered in the Northern Cascades.

Besides limestone and dolomite, the Okanogan Highlands in northeastern Washington also have a diversity of rock types of similar tectonic origin (Geology of Washington 2011). The specimen from the Kettle Range suggests its distribution may extend to the center of the Rockies on suitable substrates.

Hasse originally distinguished *Pleopsidium stenosporum* from *P. flavum* based on its immarginate apothecia and short thick paraphyses (Hasse 1897). I think Hasse discovered that *P. stenosporum* actually had a hymenium and paraphyses similar to *P. flavum* and eventually he may have seen specimens with thalline margins and sessile apothecia. Unsure about *Lecanora stenospora* but considering it probably a later name for *P. flavum*, he did not include it in his *Lichen Flora of Southern California* (Hasse 1913). This opinion is supported by another specimen identified by Hasse as *L. stenospora* from the San Gabriel Mountains at 3000 m on granite (NY!). It has a contiguous effigurate thallus and is *P. flavum*.

While this paper was out for review, I was in Yosemite National Park and Sierra National Forest with Alan Fryday and Martin Hutten. There I had the opportunity to study *Pleopsidium flavum* in the field where it grew on a quartzite rich in graphite along the Merced River in an area that was not glaciated when Yosemite Valley was carved by ice from granite. The majority of *P. flavum* specimens observed had thalli of tightly aggregated areoles with a short-lobed effigurate margin. Two specimens observed by me and one by Fryday and Hutten had some wandering tendrils of angular areoles with lobed tips connected to aggregated centers of areoles, usually with the normal effiguration along at least one thallus margin. These strands of areoles also occur in *P. discurrens*. This may be an ancestral character finding different expressions in *P. discurrens*, *P. flavum*, and *P. stenosporum*. On Stephen Sharnoff's webpage (http://www.sharnoffphotos.com/lichensF/pleopsidium_chlorophanum.html) you can see two specimens of *P. flavum*. The specimen identified as *P. chlorophanum* is the morphotype of *P. flavum* I observed in Sierra Nevada with the wandering tendrils. The specimen identified as "*P. chlorophanum* group" is the common morphotype of *P. flavum*. Environment may be a factor too. The specimens of *P. flavum* with wandering tendrils I observed at Yosemite occurred on rough quartzite surfaces in overhangs. On smoother, sun-exposed surfaces the thalli of *P. flavum* were orbicular with a short-lobed margin, the common morphotype.

I look forward to hearing from my colleagues who have unusual *Pleopsidium* or *Acarospora* specimens they think may be *P. stenosporum*. A full taxonomic description will be published when more specimens are available, chemical analysis has been completed, and it has been studied more extensively in the field. I am also open to the possibility that *P. stenosporum* may only be a rare phenotypic form of *P. flavum*, possibly caused by an interaction with edaphic factors and/or substrate aspect. What is certain is that *Lecanora stenospora* is a *Pleopsidium*.

Additional specimens of Pleopsidium stenosporum examined. – U.S.A. CALIFORNIA. [COUNTY UNKNOWN]: sine location, sine date, on unknown rock type with some HCl+ inclusions, *H.E. Hasse s.n.* (NY). WASHINGTON. FERRY CO.: Republic, Showers Butte, 20.ix.1912, on a hard HCl+ limestone, *A.S. Foster 2320* (NY).

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LITERATURE CITED

- Brodo, I.M., S. Duran Sharnoff, and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven and London. 795 pp.
- Geology of Washington. 2011. <http://www.dnr.wa.gov/ResearchScience/Topics/GeologyofWashington/Pages/ncascade.aspx> Accessed March 19, 2011
- Hafellner, J. 1993. *Acarospora* und *Pleopsidium* - zwei lichenisierte Ascomycetengattungen (Lecanorales) mit zahlreichen Konvergenzen. *Nova Hedwigia*, 56: 281-305.
- Hasse, H.E. 1897. New species of lichens from Southern California, as determined by Dr. W. Nylander and the late Dr. Stizenberger. *Bulletin of the Torrey Botanical Club*, 24: 445-449.
- Hasse, H.E. 1913. The lichen flora of southern California. *Contributions from the United States National Herbarium*, 17: 1-132.
- Haugerud, R. 1995. The Northwest Cascade System. Northwest Geological Society. http://www.nwgs.org/field_trip_guides/4.%20Northwest%20Cascades%20System.pdf. Accessed March 19, 2011
- Knudsen, K. 2007a[2008]. *Acarospora*. In T. H. Nash III, C. Gries and F. Bungartz (eds.). Lichen Flora of the Greater Sonoran Desert Region, Volume 3. Lichens Unlimited, Tempe. pp. 1–38.
- Knudsen, K.. 2007b[2008]. *Pleopsidium*. In: T.H. Nash, III, C. Gries and F. Bungartz. Lichen Flora of the Greater Sonoran Desert Region. Volume 3. Lichens Unlimited, Tempe. pp. 274-276.
- Knudsen, K. 2010. H.E. Hasse, Lichenist. *Opuscula Philolichenum*, 8: 59-66.
- Magnusson, A.H. 1929. A monograph of the genus *Acarospora*. *Kungliga Svenska Vetenskapsakademiens Handlingar*, ser. 3, 7: 1–400.
- Mindat.org. 2011. <http://www.mindat.org/loc-28245.html>. Accessed March 19, 2011
- Obermayer, W. 1996. *Pleopsidium discurrens*, comb. nova, newly discovered in southern Tibet. Lichenological results of the Sino-German Joint Expedition to southeastern and eastern Tibet 1994. II. *Annales Botanici Fennici*, 33: 231-236.
- UCR Herbarium. 2011. <http://www.herbarium.ucr.edu/Herbarium.html>. Accessed March 19, 2011

A range extension for *Heiomasia seaveyorum* north of tropical southern Florida

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ABSTRACT. – New reports of *Heiomasia seaveyorum* extend the distribution of this sterile isidiate crustose lichen to include central and northern Florida. Detailed scanning electronic micrographs are also presented to illustrate the morphology of the species.

INTRODUCTION

Recently the genus *Heiomasia* Nelsen, Lücking and Rivas Plata was described to accommodate two unusual crustose lichens that reproduce through the dispersal of lichenized diaspores (Nelsen et al. 2010). Since both species were known only from sterile specimens, their placement in the Graphidaceae s.l. (i.e. including the Thelotremaaceae), and description in a new genus was inferred from molecular phylogenetic analyses of sequence data using an approach advocated by Lendemer and Lumbsch (2008).

One of the species, *Heiomasia seaveyorum* was introduced for an isidiate taxon that was found during the 18th Tuckerman Workshop held at Fakahatchee Strand State Preserve in southern Florida (Lücking et al. 2011). Although the species was known only from the type locality when it was described, the authors speculated that the revision of herbarium material or additional fieldwork would likely lead to an expansion in its known geographic distribution.

Although I was a participant in the workshop where *Heiomasia seaveyorum* was first discovered, I did not have the opportunity to observe the species in the field or collect it. I was thus elated when Sean Beeching, a fellow participant in the workshop, sent me a specimen for identification. Upon reviewing the material Richard Harris and I searched the accumulated undetermined specimens of sterile crustose lichens with a *Trentepohlia* photobiont at The New York Botanical Garden. We were rewarded with the discovery of two additional collections that extend the range of *H. seaveyorum* to central and northern Florida. The discovery of these records confirms that the species is not restricted to the tropical portions of extreme southern Florida. The voucher specimens documenting this range extension are cited below and a map of the distribution of the species is also provided (fig. 1F).

As was pointed out by Nelsen et al. (2010), the byssoid thallus and isidioid lichenized diaspores of *Heiomasia seaveyorum* are morphologically unusual within the context of the Graphidaceae s.l. In fact, due to the photobiont type and thick ecorticate byssoid thallus, the species is likely to be confused with members of the Roccellaceae such as *Cryptothecia* Stirt., *Herpothallon* Tobler, or *Dichosporidium* Pat. Considering the aberrant morphology of *H. seaveyorum* I took the opportunity afforded by the discovery of additional material to examine a sample with a scanning electronic microscope (SEM) with the goal of producing micrographs to supplement the macroscopic illustrations presented in the protologue. This study was conducted following the protocol of Lendemer and Elix (2010) and resulting illustrations are presented here (figs. 1A-E).

Specimens examined. – **U.S.A. FLORIDA.** COLLIER CO.: Fakahatchee Strand State Preserve, Carr Hammock, 2.iii.2009, on hardwood bark, *S.Q. Beeching s.n.* (NY). DUVAL CO.: Jacksonville Beach, along Intracoastal Waterway at end of 6th Ave. N., 21.v.1976, on *Quercus*, *W.R. Buck 1366* (NY). POLK CO.: Green Swamp Wildlife Management Area, Strand Hammock, 24.iii.1998, on *Fraxinus*, *R.C. Harris 41577* (NY).

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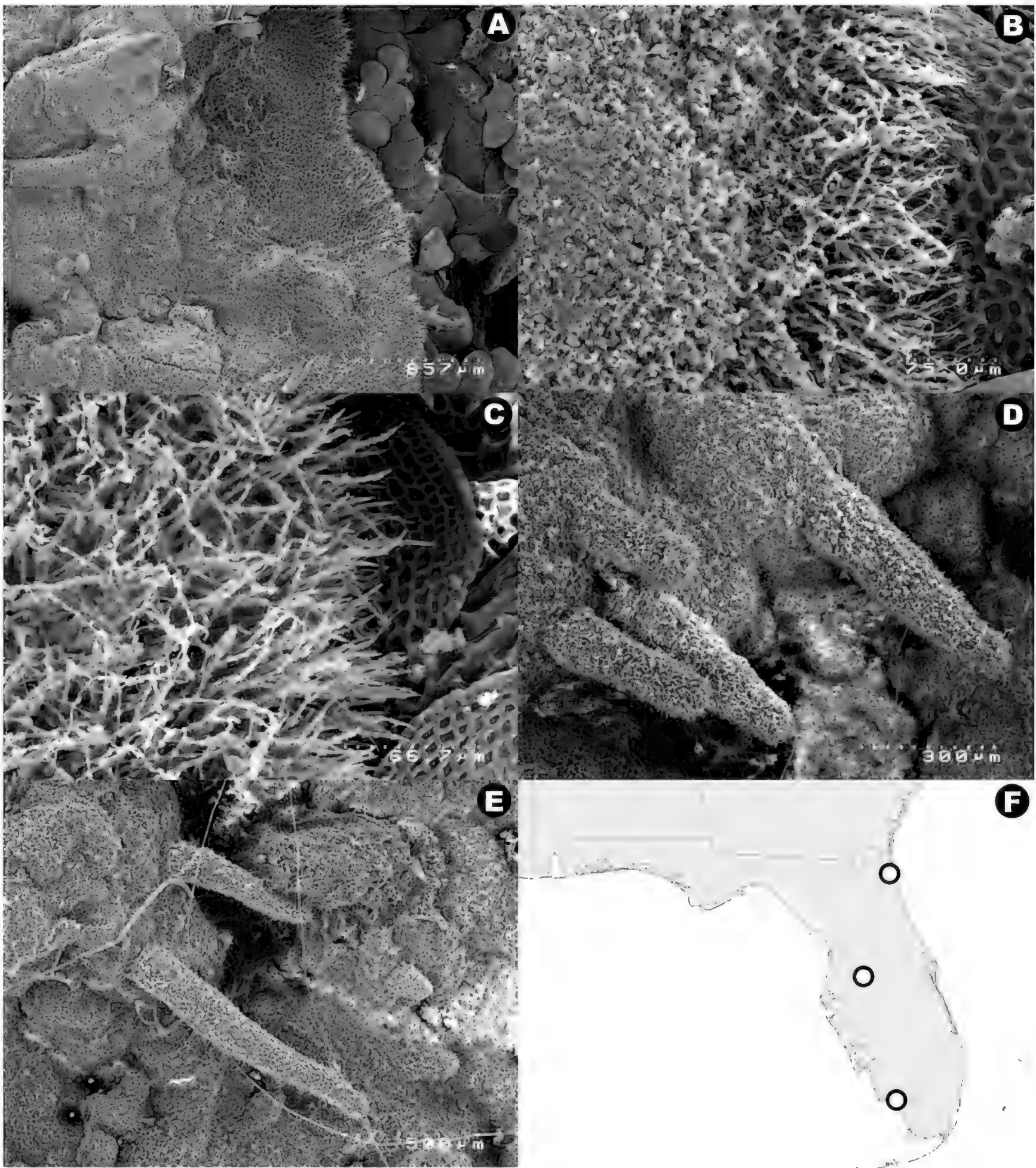


Figure 1, *Heiomasia seaveyorum* (all from *Beeching s.n.*; scales as indicated). A-C, detail of the growing edge of the thallus showing the fibrous non-lichenized prothallus extending outward over the substrate. D-E, morphological variation of the isidia, note that both the isidia and thallus are ecorticate. F, geographic range based on specimens at NY.

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LITERATURE CITED

- Lendemer, J.C. and J.A. Elix. 2010. Two new species of *Chrysothrix* from eastern North America. *Opuscula Philolichenum*, 8: 51-58.
- Lendemer, J.C. and H.T. Lumbsch. 2008. *Protoparmelia capitata* sp. nov. and *P. isidiata* Diederich, Aptroot & Sérus., two species of *Protoparmelia* (Lecanorales, Ascomycota) from southeastern North America. *The Lichenologist*, 40(4): 329-336.
- Lücking, R., F. Seavey, R.S. Common, S.Q. Beeching, O. Breuss, W.R. Buck, L. Crane, M. Hodges, B.P. Hodgkinson, E. Lay, J.C. Lendemer, R. Tory McMullin, J.A. Mercado-Diaz, M.P. Nelsen, E. Rivas Plata, W. Safranek, W.B. Sanders, H. P. Schaefer Jr., and J. Seavey. 2011. The lichens of Fakahatchee Strand Preserve State Park, Florida: Proceedings from the 18th Tuckerman Workshop. *Bulletin of the Florida Museum of Natural History*, 49(4): 127-186.
- Nelsen, M.P., R. Lücking, E. Rivas Plata, and J.S. Mbatchou. 2010. *Heiomasia*, a new genus in the lichen-forming family Graphidaceae (Ascomycota: Lecanoromycetes: Ostropales) with disjunct distribution in Southeastern North America and Southeast Asia. *The Bryologist*, 113(4): 742-451.

How should we deal with the Antarctic and Subantarctic taxa published by Carroll William Dodge?

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ABSTRACT. – The problems surrounding the Antarctic and Subantarctic taxonomic and nomenclatural novelties published by Carroll William Dodge are explained. Ways of dealing with these problems are compared, and a recommendation made as to the best way to resolve them. The nomenclatural changes that will be required if the proposed course of action is followed are listed. The generic name *Huea* C.W. Dodge and G.E. Baker is shown to be an earlier name for *Carbonea* (Hertel) Hertel rather than a genus in the Teloschistaceae, and a lectotype is designated for *Lecidea capsulata* C. W. Dodge and G. E. Baker to replace the neotype selected by Hale. *Huea grisea* (Vain.) I.M. Lamb is shown to be the correct name for *H. coralligera* (Hue) C.W. Dodge, and the correct author citation of *Hymenelia glacialis* is shown to be Øvstedal not (C.W. Dodge) Øvstedal.

INTRODUCTION

In a series of fourteen publications from 1938-1973 Carroll William Dodge described over 350 new taxa of lichenized fungi (including 11 new genera) and made around 150 new combinations from the Antarctic and Subantarctic, all from other people's collections (Dodge & Baker 1938, Dodge 1948, Dodge & Rudolph 1955, Dodge 1962, 1965a, 1965b, 1965c, 1966a, 1966b, 1968a, 1968b, 1969, 1970, 1973). The first two publications (Dodge & Baker 1938, Dodge 1948), dealing with collections made by the Second Byrd Antarctic Expedition (Dodge & Baker 1938) and the British, Australian, New Zealand Antarctic Research Expedition (B.A.N.Z.A.R.E.; Dodge 1948), are extensive treatise, both over 200 pages in length, with detailed descriptions, illustrations, and keys to species within genera, and give the appearance of being authoritative works. The other, later publications, however, include only descriptions of new taxa and new combinations; the former rarely including any comparative details separating the new taxa from already described ones, and the latter often made without any description or explanation.

This contribution summarizes Dodge's work and its subsequent interpretation, suggests four possible courses of action and recommends one of these that would minimize the adverse affect of Dodge's work on the nomenclature of Antarctic and Subantarctic lichenized fungi, and upon lichenology in the region in general.

CARROLL WILLIAM DODGE 1895–1988

Carroll W. Dodge was a well-respected figure in medical mycology (Dodge 1936) and hypogeous fungi (e.g., Dodge & Zeller 1934). He held positions at Harvard University (1921–31) and Washington University, St. Louis and the Missouri Botanical Garden (1931–63) and, after his retirement in 1963, as a Research Professor at the University of Vermont. He also taught courses on medical mycology in various South American countries from 1934–60. However, he also had an absorbing interest in lichens that went back to his undergraduate days, and these became his main preoccupation after his retirement. His earliest lichenological work was on the biota of his native NE North America (Dodge 1926), but it was a series of publications on the lichens of the neotropics (Dodge 1933, 1935, 1936) that established him as the leading American lichenologist of his day. Presumably, it was this that lead to him being asked to identify the lichens from the 2nd Byrd Antarctic Expedition, which he worked on with his post doctoral student Gladys

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Baker. The publication of this work (Dodge & Baker 1938) further extended his perceived area of expertise and established him as the leading authority on Antarctic lichens and, consequently, he was asked to work on the B.A.N.Z.A.R E. collections when these became available (Dodge 1948). Soon after this he commenced his studies of African lichens (Dodge 1953, 1956, 1957, 1959, 1964) and these two regions occupied him for the remaining 20 years of his lichenological career. Detailed biographical information, and a full list of Dodge's publications, is provided by Rudolph (1990).

AN ASSESSMENT OF DODGE'S CONTRIBUTION TO ANTARCTIC LICHENOLOGY

Llano (1951) in his review of the B.A.N.Z.A.R.E. Report (Dodge 1948) called it a "milestone in American Lichenology" but 26 years later, Almborn (1974) ended his highly critical review of Dodge's Antarctic Lichen Flora (Dodge 1973), by quoting from a letter from "another eminent lichenologist otherwise known for his moderate judgment 'This author has caused untold damage to taxonomic lichenology. His publications unfortunately cannot be simply ignored. Future serious lichenologists will have to spend much time and trouble in evaluating and identifying all his mainly useless taxa.'"

So what caused this reversal of opinion? To some extent it was a more critical appraisal of Dodge's descriptions, which revealed numerous inaccuracies and omissions (Almborn 1974, Lindsay 1974), and his scant regard for, or lack of understanding of, the rules of botanical nomenclature that caused doubt about the accuracy of his work. Lindsay (1974), for example, notes that of the seven new species that Dodge (1973) described "five of these incorrectly as *nomina nova*, two of these five not validly published", and also that "a number of new combinations published by Dodge are superfluous, since they have been published previously by other authors", whereas Almborn (1974) notes that "the author has paid too little attention to formal details" and cites "a few examples (among hundreds)". Also a factor was that Dodge was concurrently working on the taxonomy of African lichens (Dodge 1953, 1956, 1957, 1959, 1964, 1971). The African lichen biota was far better known than that of the Antarctic and, therefore, it was easier to see that Dodge's taxonomic concepts did not correspond to those of other workers (Almborn 1965, 1973).

However the conclusive factor in the reappraisal of Dodge's contribution to Antarctic lichenology was that Llano and his contemporaries did not have access to the collections upon which Dodge's new taxa were based. Dodge kept all the collections upon which he worked, including the type specimens of his new species, in his private herbarium, and it was only when this, which amounted to 75,000 collections, was donated to the Farlow Herbarium (FH) at Harvard University in 1988 that they became available to other researchers. What they discovered was beyond their wildest expectations and reduced their already low assessment of Dodge's contribution to taxonomic lichenology to almost zero. Castello and Nimis (1995), who were the first lichenologist to critically examine Dodge's Antarctic collections after his death, describe Dodge's type material thus: "What we discovered was beyond any expectation: some types were just fragments of unrecognizable sterile crusts, the same species was described several times under widely different generic names, the original descriptions do not comply with the characters of the types, the characters given for some species are a mixture of characters of different lichens growing together on the type collection". One example of the results of Castello and Nimis' (1995) investigation is reproduced here, but it is highly recommended that anyone who doubts the inaccuracies of Dodge's work should read the complete article.

Blastenia grisea C.W. Dodge and G.E. Baker

The type (Siple & Corey 73-6) consists of two very small rock fragments; the label states that they should host *Lecidea capsulata*, *Lecidea corei*, and *B. grisea*. The fragments actually host a few, small thalli of crustose lichens, none of which has "dull orange to red black apothecia"; on the smaller fragment there is a sterile crust with black fimbriate hypothalline strands which corresponds to the description of the thallus of *B. grisea*. From the type it is impossible to understand what this species really is. In the herbarium there are a few other samples purported to be *B. grisea*, and cited in Dodge (1973); Llano 2741 and 2724a are badly developed *Xanthoria elegans* (Link) Th.Fr., Schofield AA-46 is a *Caloplaca* of the *C. holocarpa*-complex, and Simple *et al.* 73-4 is another, dark-fruited *Caloplaca* with a grey thallus (a single apothecium!). The name should be best abandoned.

Hertel (1988) estimated that ca. 80% of the species created by Dodge would turn out to be synonyms, and this has been borne out by subsequent investigation. Castello and Nimis (1995) investigated the type material in FH of 152 of the 186 species described by Dodge and his co-workers from the

Antarctic continent and accepted only 31 (ca. 20%) as valid – and of these several were described in an incorrect genus and many others were so poorly developed that species-level identification was impossible. Of the remaining 121, they reduced 94 to synonymy with previously described taxa and dismissed the remainder (27) as either belonging to lichenicolous fungi or being indeterminable. The taxa described by Dodge from the Subantarctic have not been reviewed in the same detail but that they are no better than those he described from the Antarctic is confirmed by the author's inspection of Dodge's type material in FH, and the observation by Galloway (2004) that four of the five new species described by Dodge from the Snares Islands (Fineran 1969) are synonyms of previously described species, and the one that was genuinely new (*Solenopsora sordida* (C.W. Dodge) D.J. Galloway) was described in the unrelated genus *Haematomma*.

To some extent, the plethora of superfluous taxa described by Dodge can be attributed to his belief in a narrow species concept (Rudolph 1990), such that any minor variation was described as a different species, and in narrow endemism (Almborn 1974) meaning that the same species could not exist in physically separated localities. This partly explains how, among the 154 taxa treated by Castello and Nimis (1995), he could describe the common bi-polar species *Physcia caesia* (Hoffm.) Hampe ex Fűrnr. as new 12 times, but not how he could assigned these twelve species to five different genera: *Dermatiscum*, *Dirinaria*, *Pannoparmelia*, *Parmelia*, and *Physcia* – the first two the result of combining the thallus of one species and the apothecia of another, the second two due to poor taxonomy. Two of these new taxa were growing side by side on the same piece of rock, but at least Dodge placed them in the same genus – if not the correct one. His belief in narrow endemism presumably explains why he described a species such as *Phyllopyrenia macquariensis* C.W. Dodge from a single specimen from Macquarie Island as distinct from the only other species in the genus, *P. tessellata* C.W. Dodge, which he described from Îles Kerguelen, although they are morphologically identical. The latter could also partly explain why he did not provide distinguishing characters for his new species – because, as far as Dodge was concerned, the mere fact that they occurred at different localities was in itself enough to distinguishing them. However, this cannot explain how Dodge managed to provide such inaccurate descriptions with unerring regularity. For example, he described the new species *Schismatomma fuegiensis* [sic] C.W. Dodge (1966b) as having ascospores “ellipsoid to subfusiform, 4-locular, $18 \times 3 \mu\text{m}$ ” and the photobiont as “*Trentepohlia*” whereas the ascospores are simple, ca. $10\text{--}12 \times 5\text{--}6 \mu\text{m}$ and the photobiont is a green chlorococcoid alga. Presumably, he mistook the septate paraphyses for ascospores. The type, and only, specimen of this taxon was collected by Gerhard Follmann and, as is usual for this collector, is well-developed and clearly referable to *Tephromela skottsbergii* (Darb.) Fryday (Fryday 2011), which is closely related to the common *T. atra* (Huds.) Hafellner. The rest of Dodge's description is fairly accurate (e.g., “Apothecia sessile, 1.2–1.5 mm in diameter, margins white, entire: disc subconvex, black, nitid...”) – although how he failed to mention the bright purple hymenium characteristic of this group is remarkable – and clearly indicates that this was the specimen he was describing under this name.

Many of the worst problems with Dodge's taxonomic work, and the difficulties involved in trying to resolve them, can be illustrated by the genus *Huea* C.W. Dodge and G.E. Baker (1938). *Huea* was erected for a group of Antarctic species in the large cosmopolitan genus *Caloplaca* Th. Fr. that were characterized by lacking anthraquinones, and having black apothecia with a carbonaceous exciple and a bright blue epihymenium. Dodge and Baker (1938) transferred two species originally described in the genus *Lecidea* by Hue in 1915 to their new genus as *H. cerussata* (Hue) C.W. Dodge and G.E. Baker and *H. coralligera* (Hue) C.W. Dodge and G.E. Baker, but chose as the type species their newly described species, *Huea flava* C.W. Dodge and G.E. Baker. The type specimen of *H. flava* (and hence of the genus) is on a flat piece of rock with numerous small labels indicating individual species that are then named on the packet. The lichen identified as the type specimen of *H. flava* is a white, sterile crust on the edge of the underside of the rock, and this has resulted in all previous investigators (and, initially, the present author) concluding that the specimen was unidentifiable and that the genus *Huea* was impossible to typify on this specimen. However, closer examination reveals that this same sterile crust extends around to the side of the rock where it is abundantly fertile and there is another label identifying it (correctly) as *Lecidea capsulata* C.W. Dodge and G.E. Baker. As the part of the specimen designated as *L. capsulata* is abundantly fertile while the part designated as *H. flava* is sterile, the former epithet is taken up here for this species. This specimen of *L. capsulata* (P. Siple & S. Corey 73-10) is mentioned by Dodge and Baker (1938) in their protologue and, therefore, is part of the original collection and must be designated as the lectotype of *L. capsulata* in preference to the neotype (Molholm 7; US—neotype, OS—isoneotype) selected by Hale (1987; ICBN Art. 9.17). *Lecidea capsulata* was transferred to *Carbonea* (Hertel) Hertel as *Carbonea*

capsulata (C.W. Dodge and G.E. Baker) Hale (Hale 1987), and later reduced to synonymy with *C. vorticosa* (Flörke) Hertel (Øvstedal & Lewis Smith 2001), which means that the name *Huea* is not correctly applied to a group of species in the Teloschistaceae but is an earlier name for *Carbonea*, a relatively recently erected genus (Hertel 1993) in the Lecanoraceae containing ca. 25 species. A simple proposal to reject the name *Huea* would protect *Carbonea* but the situation is complicated because the other species transferred to *Huea* by Dodge and Baker (1938) were believed by Sørchting et al. (2004) to form a distinct clade in *Caloplaca* so it may be preferable to conserve *Huea* with a conserved type. Sørchting et al. (2004) advocated this course of action and designated *H. coralligera* as a neotype but, because they did not do so as a formal proposal, this has no relevance.

In their protologue to *Huea*, Dodge and Baker (1938) cited four specimens of *H. flava*, but chose as the type a specimen lacking apothecia. The only other specimens mentioned in the protologue still present in FH (*Simple* 72A-1, 73-7) are also sterile crusts. Also in FH are two permanent slides labeled as *H. flava* (Box 71: 79 & 80), although neither specimen from which they were prepared is in FH nor mentioned in the protologue. One of these slides (79) probably does represent a species of *Huea* (sensu Dodge & Baker), although the ascospores (12 x 8 µm) are too large for *H. flava*, whereas the ascospores of the other slide (80) are simple (8 x 4 µm) and the exciple and hypothecium are uniformly dark blue-black. The specimen from which this slide was prepared was probably a species of *Carbonea* and is confirmation that Dodge confused simple and polarilocular ascospores. Further evidence of Dodge's inability to distinguish a simple spore from a polarilocular one, and that *Huea* is congeneric with *Carbonea*, is provided by Dodge's subsequent (Dodge 1948) description of the new species *Huea smaragdula* C.W. Dodge, which was shown to be a synonym of *Carbonea capsulata* by Castello and Nimis (1995). In fact, with the obvious exception of the description of the ascospores as 'bipolarilocular', Dodge and Baker's description of *H. flava* resembles that of a species of *Carbonea* in all other respects and is very similar to that of *L. capsulata* – although Dodge fails to mention the carbonaceous exciple of *L. capsulata*. In particular, the ascospore dimensions given for *H. flava*, which are very small for a species of Teloschistaceae and significantly smaller than those of the other species transferred to *Huea*, are almost identical to those given for *L. capsulata*.

ALTERNATIVE COURSES OF ACTION

Dodge's names have been described as one of the greatest impediments to progress in understanding the Antarctic lichen biota (Hertel 1988, Castello & Nimis 1995). Only 39 of Dodge's ca. 350 names are in current use and a little over 100 have been reduced to synonymy with previously described species, leaving over 225 new names that are available and are a potentially seriously destabilizing influence on southern polar lichenology (Table 1). There are four possible courses of action, which are explained in the following sections in increasing degree of intervention.

Category	Number	Number of proposals to reject
Good species, correct genus	10	–
Good species, wrong genus	18	–
Synonyms	112	–
Probable synonyms	9	9
Indeterminate	14	14
Unknown	203	203
TOTAL	366	226

Table 1: Status of new taxa described by C.W. Dodge and co-workers

1) DEAL WITH THE NAMES ON AN *AD HOC* BASIS WHEN THEY BECOME RELEVANT

Leaving Dodge's names as validly published, to be dealt with as and when necessary, would result in much ultimately futile nomenclatural research and have a potentially destabilizing effect on the nomenclature of the southern polar lichen biota if a newly described species is then found to correspond to a Dodge type specimen. Dodge's epithets are often published in a completely unrelated genus and so, in order to avoid this, it would be necessary to check all of Dodge's type material every time a new species was described to ensure that it hadn't previously been described by Dodge.

Only about 200 type specimens are present in the Dodge herbarium at FH (A. Fryday, unpublished data) and, of these, 152 were dealt with by Castello and Nimis (1995). The whereabouts of the remaining 150 is unknown but it is probable that potential lectotypes for these species exist elsewhere in Dodge's herbarium, as is the case for *Lecidea capsulata* (see above) or among his extensive slide collection (e.g., Hawksworth & Iturriaga 2006). Many of the 50 species for which a type specimen exists but were not studied by Nimis and Castello (1995) will ultimately be reduced to synonymy, but for those for which the type is missing or indeterminate, it will be necessary to either select an epitype or neotype, or to formally reject the name. The former is often impossible because of the inaccuracy of Dodge's published descriptions and the widely differing identities of the other collections he included under a name, so most of these names will ultimately require a formal proposal to reject.

2) INDIVIDUAL PROPOSALS TO REJECT ALL DODGE'S NAMES THAT ARE NOT IN CURRENT USE OR REDUCED TO SYNONYMY

This would involve around 225 individual proposals to reject. Admittedly this could be done in groups (i.e., names not used since proposed, names for which the type specimen is lost, names for which the type specimen is indeterminable, etc.) but it would still add around 225 names to the *nomina utique rejicienda*. The *nomina utique rejicienda* for fungi currently lists 42 names (mostly conserved against earlier names or with a conserved type) so to add another 225 names to this list would seriously inflate it. Rejecting most of Dodge's names while maintaining a few would also lead to potential confusion because future workers would have to check whether a name had been formally rejected or not.

A further consideration against both these first two courses of action that preserve some of Dodge's names is that the purpose of the ICBN is to promote stability of plant and fungal names and establish priority, not to compensate for, or excuse bad taxonomic practice, and it is difficult to see how either objective is advanced by the use of names for which the diagnosis and description are inaccurate and the type specimen inadequate. If Dodge's names are allowed to stand it would reward his poor taxonomy at the expense of later researchers where they have subsequently described the same species with an accurate description and a good type specimen – unaware of Dodge's name hidden away in an unrelated genus. In fact, because Dodge's descriptions and type specimens are so poor, if his names are allowed to stand it would, in many cases, be necessary for authors taking up his names to provide a full description and designate a specimen as an epitype of Dodge's name.

3) ADD ALL DODGE'S ANTARCTIC AND SUBANTARCTIC TAXA PUBLICATIONS TO THE LIST OF *OPERA UTIQUE OPPRESSA*

The introduction of the list of *opera utique oppressa* in the Tokyo Code (Art. 32.8 and App. V; Vienna Code Art. 32.9 and App. VI) provided an avenue for the elimination of potentially destabilizing works from nomenclatural consideration. This option was initially introduced primarily for works that do not consistently use the binary system of species nomenclature, but Lumbsch et al (1999) successfully proposed that a recent, posthumously published work by the Polish lichenologist Josef Motyka (1900-1984; Motyka, J. 1995-1996. Porosty (Lichenes). Rodzina Lecanoraceae. 4 vol. Lublin) be added to the list of suppressed works and that the names of genera and species included in that work be treated as not validly published. If all Dodge's Antarctic and Subantarctic taxa publications are added to the list of *opera utique oppressa*, this precedent would be further extended to apply to a series of journal articles. This proposal is further controversial in that among the ca. 350 names proposed by Dodge in these publications 39 are in current use, although some of these are homonyms. For example, the correct name for *Huea coralligera* is *Huea grisea* (Vain.) I.M. Lamb because the basionym of this name (*Pertusaria grisea* Vain. described in 1903), predates the basionym of *Huea coralligera* (*Lecidea coralligera* Hue described in 1923), whereas the name *Aspicilia glacialis* C.W. Dodge (described in 1968) is illegitimate because it is a later homonym of *Aspicilia glacialis* (Arnold) Dalla Torre and Sarnth. (described in 1902), although the name was

validated by Øvstedal when he transferred it to *Hymenelia* and so is available as *Hymenelia glacialis* Øvstedal (ICBN Art. 58.1).

However, although Dodge's names would no longer be validly published, they would still be effectively published and, consequently, those names that have subsequently been transferred to other genera (18) would have been validly published as new species under that name (ICBN Art. 58.1; e.g., *Haematomma sordidum* C.W. Dodge, which has been transferred to *Solenopsora* as *S. sordida* (C.W. Dodge) D.J. Galloway, would become *Solenopsora sordida* D.J. Galloway), whereas most others (13) could be preserved, with an emended author citation (e.g., C.W. Dodge ex Fryday in place of C.W. Dodge), by a full and direct reference to the original publication (ICBN Arts 32.5, 33.4), as was inadvertently done, for example, by Hale (1987) for *Acarospora gwynnii* C.W. Dodge and E.D. Rudolph, *Buellia grisea* C.W. Dodge and G.E. Baker and *Lecidea siplei* C.W. Dodge and G.E. Baker. Only in those few cases (5) where the same species has subsequently been described by another author, unaware that it had been previously described by Dodge (often in an unrelated genus), would a change of name be necessary (e.g., *Candelariella flava* (C.W. Dodge & Baker) Castello & Nimis (basonym *Protoblastenia flava* C.W. Dodge) would be replaced by *Candelariella hallettensis* (B.J. Murray) Øvstedal). This course of action would also resolve the *Huea* problem detailed above because, by adding Dodge and Baker (1938) to the list of *opera utique oppressa*, the genus *Huea* and all subsequent combinations in the genus would become invalid. However, the name would still be effectively published and could be validated by a full and direct reference to the original description and a new type chosen.

The current list of *opera oppressa* contains about 30 titles and so adding Dodge's Antarctic and Subantarctic journal articles to it would inflate it by around 50%. However, this is nowhere near the greater than 400% increase to the *nomina utique rejicienda* that would occur if the previous solution is adopted. This solution also has the advantage over the previous solution that, if a new name or combination is mistakenly omitted from the list of preserved names, the name can easily be re-instated by a subsequent author, whereas, in the previous solution, if a name in current use is mistakenly included in the list of names to be rejected, it will be much more difficult to re-instate.

Although these changes are regrettable and will undoubtedly cause a short-term destabilization to lichen nomenclature, this will be confined to a very limited geographic area and is a small price to pay for the removal from consideration of ca. 225 potentially disruptive names that would otherwise have a long and lasting destabilizing effect. The required nomenclatural changes are listed in Table 2 (Appendix 1).

4) PROPOSAL TO EMEND THE ICBN TO INCLUDE THE CATEGORY *AUCTORES OPPRESSA*, FOLLOWED BY A PROPOSAL TO ADD C.W. DODGE TO THIS LIST.

The advantage of this would be that many hundreds of useless names could be got rid of at a stroke and, after it had been done, everyone would know that all the names published by an *auctor oppressus* could simply be ignored. The arguments against are, as in suggestion 3), that a small number of good names would also become invalidly published, and that it would be superfluous as the same result could be attained by adding all the publications of the author concerned to the list of *opera utique oppressa*.

CONCLUSION

It appears that Dodge's taxonomic work in other geographic areas was no better than his Antarctic/Subantarctic work (Almborn 1965, 1973, R. Lücking & T. Ahti *pers. comms*), but that problem is better dealt with by others with a better knowledge of this aspect of his work. Dodge was also far from the only author guilty of poor taxonomic practice that has had a detrimental and destabilizing effect on lichenological nomenclature (e.g., Gyelnik, Motyka, Servit) but, again, this is better dealt with by others with a better knowledge of the work of those authors. These other authors are also more problematic because, in many cases, far more of their names are in current use.

The simplest method of resolving the problem of Dodge's Antarctic/Subantarctic lichen names would be a proposal to emend the ICBN to include the category *auctores oppressa*, to which Dodge's name could then be added (Option 4). This would also permit other workers to propose the addition of other taxonomists to this list whose work has a destabilizing effect that outweighs the short-term confusion caused by a limited number of adjustments to species names or author citations. However, I am unfamiliar with Dodge's other work and as Dodge is also well-respected in the fields of medical mycology and hypogeous fungi, a proposal to suppress all his nomenclatural novelties would be ill-advised and unlikely to succeed. Therefore, it is my opinion that by far the best course of action is to add all Dodge's Antarctic

and Subantarctic taxonomic publications to the list of *opera utique oppressa* (Option 3) and a formal proposal to this effect will be submitted to *Taxon*. I welcome comments, opinions and contributions from others in the lichenological community in the drafting of this proposal.

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LITERATURE CITED

- Almborn, O. 1965. Review of "Dodge, Carroll W.: Some Lichens of Tropical Africa. IV. *Dermatocarpaceae* to *Pertusariaceae*". *Botaniska Notiser*, 118: 131–132.
- Almborn, O. 1973. Review of "Dodge, Carroll W.: Some Lichens of Tropical Africa. V. *Lecanoraceae* to *Physciaceae*". *Botaniska Notiser*, 127: 270–271.
- Almborn, O. 1974. Review of "Dodge, Carroll W.: Lichen Flora of the Antarctic Continent and Adjacent Islands". *Botaniska Notiser*, 126: 454–455.
- Castello, M. and P.L. Nimis. 1995. A critical revision of Antarctic lichens described by C. W. Dodge. *Bibliotheca Lichenologica*, 57: 71–92.
- Dodge, C.W. 1926. Lichens of the Gaspé peninsula, Quebec. *Rhodora*, 28: 157–161, 205–207, 225–232.
- Dodge, C.W. 1933. The foliose and fruticose lichens of Costa Rica I. *Annals of the Missouri Botanical Garden*, 20: 373–467.
- Dodge, C.W. 1935. Lichens. p. 221. *In*: H.K. Svenson, Plants of the Astor Expedition, 1930. *American Journal of Botany*, 22: 208–277.
- Dodge, C.W. 1936. Lichens of the G. Allan Hancock expedition of 1934, collected by Wm. R. Taylor. *The Hancock Pacific Expeditions*, 3: 33–46.
- Dodge, C.W. 1948. Antarctic Research Expedition 1929–1931 vol. VII. Lichens and lichen parasites. *Rep. B.A.N.Z. antarct. Exped. Res.*, 7: 1–276.
- Dodge, C.W. 1953. Some lichens from tropical Africa. *Annals of the Missouri Botanical Garden*, 40(4): 271–401.
- Dodge, C.W. 1956. Some lichens of tropical Africa. II. *Usnea*. *Annals of the Missouri Botanical Garden*, 43: 381–396.
- Dodge, C.W. 1957. Some lichens of tropical Africa. II. *Usnea*. *Annals of the Missouri Botanical Garden*, 44: 1–76.
- Dodge, C.W. 1959. Some lichens of tropical Africa. III. *Parmeliaceae*. *Annals of the Missouri Botanical Garden*, 46: 39–193.
- Dodge, C.W. 1962. Expedition antarctique belge. Lichens. *Bull. Jard. Bot. de l'Etat [Bruxelles]*, 32(3): 301–308.
- Dodge, C.W. 1964. Some Lichens of Tropical Africa. IV. *Dermatocarpaceae* to *Pertusariaceae*. *Beihefte zur Nova Hedwigia*, 12: 1–282.
- Dodge, C.W. 1965a. Lichenological notes on the flora of the Antarctic Continent and the subantarctic islands—V. Tierra del Fuego and the Falkland Islands. *Transcripts of the American Microscopical Society*, 84(4): 502–507.
- Dodge, C.W. 1965b. Lichenological notes on the flora of the Antarctic Continent and the subantarctic islands—VI. New taxa from the Antarctic Continent and adjacent islands. *Transcripts of the American Microscopical Society*, 84(4): 507–529.
- Dodge, C.W. 1965c. Lichens. *In*: P. van Oye and J. van Mieghen (eds.): *Biogeography and Ecology in Antarctica*. xxcii + 762 pp. 146 fig. 24 pl. Dr. W. Junk, Publishers, The Hague, 194–200.
- Dodge, C.W. 1965d. Liqueues de las Islas Shetland del Sur de la Tierra de O'Higgins (Peninsula Antarctica) recolectados por Gehard Follmann. *Inst. Antartico Chileno* 6: 1–12.
- Dodge, C.W. 1966a. Lichens from Kerguelen collected by E. Aubert de la Rue. *Comite Francais des Recherches Antarctiques [Paris]* 15: 1–8.
- Dodge, C.W. 1966b. New lichens from Chile. *Nova Hedwigia* 12: 307–352.
- Dodge, C.W. 1968a. Lichenological notes on the flora of the Antarctic Continent and the subantarctic islands. VII and VIII. *Nova Hedwigia* 15: 285–332.
- Dodge, C.W. 1968b. New lichens from Chile—II. *Nova Hedwigia* 16: 481–494.
- Dodge, C.W. 1969. Lichens. *In*: The flora of the Snares Islands, New Zealand.; pp. 245–250. B.A. Fineran, Trans. Roy. Soc. New Zealand, Bot., 3: 237–270.
- Dodge, C.W. 1970. Lichenological notes on the flora of the Antarctic Continent and the subantarctic islands IX–XI. *Nova Hedwigia*, 19: 439–502.
- Dodge, C.W. 1971. Some lichens of tropical Africa. V. *Lecanoraceae* to *Physciaceae*. *Beihefte zur Nova Hedwigia*, 38: 1–225.
- Dodge, C.W. 1973. Lichen Flora of the Antarctic Continent and Adjacent Islands. Phoenix Publishing Co., Canaan, New Hampshire. xii + 389 pp.

- Dodge, C.W. and G.E. Baker. 1938. The Second Byrd Antarctic Expedition. Botany. II. Lichens and lichen parasites. *Annals of the Missouri Botanical Garden*, 25: 515–718.
- Dodge, C.W. and E.D. Rudolph. 1955. Lichenological notes on the flora of the Antarctic Continent and the subantarctic islands. I-IV. *Annals of the Missouri Botanical Garden*, 42(2): 131–149.
- Dodge, C.W. and S.M. Zeller. 1934. *Hymenogaster* and related genera. *Annals Missouri Botanical Garden*, 21: 625–708.
- Fineran, B.A. 1969. The flora of the Snares Islands New Zealand. *Trans. Roy. Soc. New Zealand, Bot.*, 3: 237–270.
- Fryday, A.M. 2011. New species and combinations in *Calvitimela* and *Tephromela* from the southern subpolar region. *Lichenologist* 43: 225–239.
- Galloway, D.J. 2004. Notes on some lichen names recorded from the Snares Islands, southern New Zealand. *Australasian Lichenology*, 55: 21–25
- Hale, M.E. 1987. Epilithic lichens in the Beacon sandstone formation, Victoria Land, Antarctica. *Lichenologist*, 19: 269–287.
- Hawksworth D.L. and T. Iturriaga. 2006. Lichenicolous fungi described from Antarctica and the sub-Antarctic islands by Carroll W. Dodge (1895–1988). *Antarctic Science*, 18: 291–301.
- Hertel, H. 1988. Problems in monographing Antarctic crustose lichens. *Polarforschung*, 58: 65–76.
- Hertel, H. 1993. Über einige aus *Lecidea* und *Melanolecia* (Ascomycetes lichenisati) auszuschliessende Arten. *Mitteilungen der Botanischen Staatssammlung München*, 19: 441–447
- Lindsay, D.C. 1974. Book Review: “Carroll W. Dodge: *Lichen Flora of the Antarctic Continent and adjacent islands*”. *Lichenologist*, 6:130–133.
- Llano, G.A. 1951. [Review of:] Carrol W. Dodge: Lichens and Parasites. B.A.N.Z. Antarctic Research Expedition 1929–1931 Under the Command of Sir Douglas Mawson. Reports–Series B (Zoology and Botany). Vol. VII. B.A.N.Z.A.R. Expedition Committee and issued through the Barr Smith Library, University of Adelaide, Adelaide, Australia. 60s (paper). 276 pp. 1948. *Quart. Rev. Biol.*, 26: 58–59.
- Lumbsch, H.T., D.L. Hawksworth and B.J. Coppins. 1999. (1406) Proposal to Add Motyka's Four-Volume Work on Lecanoraceae to the “opera utique oppressa”. *Taxon*, 48: 183–185.
- Øvstedal, D.O. and R.I. Lewis Smith. 2001. Lichens of Antarctica and South Georgia: A Guide to Their Identification and Ecology. *Studies in Polar Research*, Cambridge University Press, Cambridge, England.
- Matzer, M. 1993. Beitrag zur Kenntnis der Ascomycetengattungen *Globosphaeria*, *Roselliniopsis* und *Synaptospora*. *Cryptogamie, Mycologie*, 14: 11–19.
- Rudolph, E.D. 1990. Carroll William Dodge, 1895–1988. *Mycologia*, 82: 160–164.
- Sochting, U., D.O. Øvstedal and L.G. Sancho. 2004. The lichens of Hurd Peninsula, Livingston Island, South Shetlands, Antarctica. *Bibliotheca Lichenologica*, 88: 607–658.

APPENDIX 1 - NEW NAMES AND AUTHOR CITATIONS THAT WOULD BE REQUIRED IF ALL C.W. DODGE’S ANTARCTIC AND SUBANTARCTIC PUBLICATIONS ARE ADDED TO THE LIST OF *OPERA UTIQUE OPPRESSA* (CHANGES IN BOLD)

Table 2. New names and author citations that would be required if all C.W. Dodge’s Antarctic and Subantarctic publications are added to the list of *opera utique oppressa* (changes in bold)

Current Name	Date	Dodge Name	Date	New Name	Date of Priority
<i>Acarospora austroshetlandica</i> (C.W. Dodge) Øvstedal	2001	<i>Biatorella austroshetlandica</i> C.W. Dodge	1965	<i>Acarospora austroshetlandica</i> Øvstedal	2001
<i>Acarospora gwynnii</i> C.W. Dodge & E.D. Rudolph	1955	<i>Acarospora gwynnii</i> C.W. Dodge & E.D. Rudolph	1955	<i>Acarospora gwynnii</i> C.W. Dodge & E.D. Rudolph ex Hale	1987
<i>Arthonia parmeliae</i> (C.W. Dodge & G.E. Baker) D. Hawksw. & Iturr.	2006	<i>Diplonaevia parmeliae</i> C.W. Dodge & G.E. Baker	1938	<i>Arthonia parmeliae</i> D. Hawksw. & Iturr.	2006
<i>Bacidia johnstonii</i> C.W. Dodge	1948	<i>Bacidia johnstonii</i> C.W. Dodge	1948	<i>Bacidia johnstonii</i> C.W. Dodge ex [validating author]	–
<i>Buellia granulosa</i> (Darb.) C.W. Dodge	1948	<i>Buellia granulosa</i> (Darb.) C.W. Dodge	1948	<i>Buellia granulosa</i> (Darb.) C.W. Dodge ex [validating author]	–
<i>Buellia grisea</i> C.W. Dodge & G.E. Baker	1938	<i>Buellia grisea</i> C.W. Dodge & G.E. Baker	1938	<i>Buellia grisea</i> C.W. Dodge & G.E. Baker ex Hale	1987

<i>Buellia pallida</i> C.W. Dodge & G.E. Baker	1938	<i>Buellia pallida</i> C.W. Dodge & G.E. Baker	1938	<i>Buellia foecunda</i> Filson	1966
<i>Caloplaca hookeri</i> (C.W. Dodge) Söchting, Øvstedal & Sancho	2004	<i>Gasparrinia hookeri</i> C.W. Dodge	1965	<i>Caloplaca hookeri</i> Söchting, Øvstedal & Sancho	2004
<i>Caloplaca johnstonii</i> (C.W. Dodge) Söchting & Olech	1995	<i>Blastenia johnstonii</i> C.W. Dodge	1948	<i>Caloplaca tenuis</i> Øvstedal	1986
<i>Caloplaca schofieldii</i> C.W. Dodge	1968	<i>Caloplaca schofieldii</i> C.W. Dodge	1968	<i>Caloplaca schofieldii</i> C.W. Dodge ex [validating author]	–
<i>Candelariella flava</i> (C.W. Dodge & Baker) Castello & Nimis	1994	<i>Protoblastenia flava</i> C.W. Dodge & Baker	1938	<i>Candelariella hallettensis</i> (B.J. Murray) Øvstedal	1983¹
<i>Carbonea antarctica</i> (C.W. Dodge & G.E. Baker) D. Hawksw. & Iturr.,	2006	<i>Alectoria antarctica</i> C.W. Dodge & G.E. Baker	1938	<i>Carbonea antarctica</i> D. Hawksw. & Iturr.	2006
<i>Cladonia cervicornis</i> subsp. <i>mawsonii</i> (C.W. Dodge) Stenroos & Ahti	1990	<i>Cladonia mawsonii</i> C.W. Dodge	1948	<i>Cladonia cervicornis</i> subsp. <i>mawsonii</i> Stenroos & Ahti	1990
<i>Degelia neozelandica</i> (C.W. Dodge) Jørgensen & Galloway	1992	<i>Steinera neozelandica</i> C.W. Dodge	1970	<i>Degelia neozelandica</i> (D.J. Galloway & P. James) Jørgensen & D.J. Galloway	1984²
<i>Endococcus matzerii</i> D. Hawksw. & Iturr	2006			<i>Endococcus buelliae</i> Matzer	1993
<i>Huea</i> C.W. Dodge & G.E. Baker	1938	<i>Huea</i> C.W. Dodge & G.E. Baker	1938	<i>Huea</i> C.W. Dodge & G.E. Baker ex [validating author]	–
<i>Huea cerussata</i> (Hue) C.W. Dodge & G.E. Baker	1938	<i>Huea cerussata</i> (Hue) C.W. Dodge & G.E. Baker	1938	<i>Huea cerussata</i> (Hue) C.W. Dodge & G.E. Baker ex [validating author]	–
<i>Huea coralligera</i> (Hue) C.W. Dodge & G.E. Baker	1939	<i>Huea coralligera</i> (Hue) C.W. Dodge & G.E. Baker	1938	<i>Huea grisea</i> (Vain.) I.M. Lamb ex [validating author]	–
<i>Huea diphyella</i> (Nyl.) C.W. Dodge	1948	<i>Huea diphyella</i> (Nyl.) C.W. Dodge	1948	<i>Huea diphyella</i> (Nyl.) C.W. Dodge & G.E. Baker ex [validating author]	–
<i>Huea sorediata</i> Øvstedal	2001			<i>Huea sorediata</i> Øvstedal ex [validating author]	–
<i>Hymenelia glacialis</i> (C.W. Dodge) Øvstedal	2001	<i>Aspicilia glacialis</i> C.W. Dodge <i>nom. inval.</i> ³	1968	<i>Hymenelia glacialis</i> Øvstedal	2001
<i>Lecanora mawsonii</i> C.W. Dodge	1948	<i>Lecanora mawsonii</i> C.W. Dodge	1948	<i>Lecanora mawsonii</i> C.W. Dodge ex [validating author]	–
<i>Lecidea cancriformis</i> C.W. Dodge & G.E. Baker	1938	<i>Lecidea cancriformis</i> C.W. Dodge & G.E. Baker	1938	<i>Lecidea phillipsiana</i> Filson	1966
<i>Lecidea medusula</i> (C.W. Dodge) Hertel	1998	<i>Sarcogyne medusula</i> C.W. Dodge	1973	<i>Lecidea medusula</i> Hertel	1998
<i>Lecidella siplei</i> (C.W. Dodge & G.E. Baker) May. Inoue	1991	<i>Lecidea siplei</i> C.W. Dodge & G.E. Baker	1938	<i>Lecidella siplei</i> (Hale) May. Inoue	1987⁴

<i>Peltigera aubertii</i> C.W. Dodge	1966	<i>Peltigera aubertii</i> C.W. Dodge	1966	<i>Peltigera aubertii</i> C.W. Dodge ex Vitik.	2002
<i>Phacopsis usneae</i> C.W. Dodge	2006	<i>Phacopsis usneae</i> C.W. Dodge	1948	<i>Phacopsis usneae</i> C.W. Dodge ex D. Hawksw. & Iturr	2006
<i>Polycoccum follmannii</i> (C.W. Dodge) Alstrup	2002	<i>Heterocarpon follmannii</i> C.W. Dodge	1968	<i>Polycoccum follmannii</i> Alstrup	2002
<i>Rhizoplaca macleanii</i> (C.W. Dodge) Castello	2010	<i>Lecanora macleanii</i> C. W. Dodge	1948	<i>Rhizoplaca macleanii</i> Castello	2010
<i>Rinodina olivaceobrunnea</i> C.W. Dodge & G.E. Baker	1938	<i>Rinodina olivaceobrunnea</i> C.W. Dodge & G.E. Baker	1938	<i>Rinodina archaeoides</i> H. Magn.	1947
<i>Solenopsora sordida</i> (C.W. Dodge) D.J. Galloway	2004	<i>Haematomma sordidum</i> C.W. Dodge	1969	<i>Solenopsora sordida</i> D.J. Galloway	2004
<i>Sphaerellothecium buelliae</i> (C.W. Dodge) D. Hawksw. & Iterr.	2006	<i>Orbicula buelliae</i> C.W. Dodge	1948	<i>Sphaerellothecium buelliae</i> D. Hawksw. & Iterr.	2006
<i>Tephromela priestleyi</i> (C.W. Dodge) Øvstedal	1965	<i>Lecanora (Squamaria) priestleyi</i> C. W. Dodge	1965	<i>Tephromela priestleyi</i> (Seppelt) Øvstedal	1996 ⁵
<i>Thelenella mawsonii</i> (C.W. Dodge) H. Mayrhofer & P.M. McCarthy	1991	<i>Microgleana mawsoni</i> C.W. Dodge	1948	<i>Thelenella mawsonii</i> H. Mayrhofer & P.M. McCarthy	1991
<i>Topeliopsis macrocarpa</i> (C.W. Dodge) Mangold & Lumbsch	2009	<i>Thelotrema macrocarpum</i> C.W. Dodge	1970	<i>Topeliopsis australis</i> (Kantvilas & Vězda) [validating author]	2000 ⁶
<i>Oevstedalia antarctica</i> (C.W. Dodge) Ertz & Diederich	1968	<i>Trimmatothelopsis antarctica</i> C.W. Dodge	1968	<i>Oevstedalia antarctica</i> Ertz & Diederich	2004
<i>Umbilicaria cristata</i> C.W. Dodge & G.E. Baker	1938	<i>Umbilicaria cristata</i> C.W. Dodge & G.E. Baker	1938	<i>Umbilicaria cristata</i> C.W. Dodge & G.E. Baker ex [validating author]	–
<i>Weddellomyces gasparrinae</i> (C.W. Dodge) D. Hawksw. & Iturr.	2006	<i>Phaeospora gasparrinae</i> C.W. Dodge	1948	<i>Weddellomyces gasparrinae</i> D. Hawksw. & Iturr.	2006
<i>Zwackhiomyces cladoniae</i> (C.W. Dodge) Diederich	2006	<i>Didymella cladoniae</i> C.W. Dodge	1948	<i>Zwackhiomyces cladoniae</i> Diederich	1997

¹ Basionym: *Lecidea hallettensis* B.J. Murray, 1963; Synonym: *Protoblastenia hallettensis* (B.J. Murray) C.W. Dodge, 1973

² Validated by *Parmeliella neozelandica* D.J. Galloway & P. James, 1984

³ Homonym of *Aspicilia glacialis* (Arnold) Dalla Torre & Sarnth., 1902

⁴ Validated by *Lecidea siplei* C.W. Dodge & G.E. Baker ex Hale, 1987

⁵ Validated by *Rhizoplaca priestleyi* Seppelt, 1996

⁶ Basionym: *Chroodiscus australis* Kantvilas & Vězda, 2000

How do you reconcile molecular and non-molecular datasets? A case study where new molecular data prompts a revision of *Peltigera hydrothyria* s.l. in North America and the recognition of two species

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ABSTRACT. – A revision of the aquatic macrolichen *Peltigera hydrothyria* utilizing biogeographical, chemical, morphological, and ITS1, 5.8s, and ITS2 nrDNA sequence data is presented. Phylogenetic analyses of the molecular data revealed three strongly supported clades representing one cryptic and two non-cryptic taxa. The name *P. hydrothyria* is restricted to eastern North American populations while the allopatric chemically distinct populations from western North America are recognized as a distinct species, *P. gowardii*. *Peltigera gowardii* is circumscribed broadly to include two distinct phylogenetic entities. These findings illustrate the utility of characteristics such as geography and secondary chemistry in delimiting otherwise morphologically cryptic species when combined with molecular data.

INTRODUCTION

The genus *Peltigera* Willd. comprises a group of charismatic moisture-loving macrolichens represented in North America by thirty seven species (Esslinger 2010). Members of the genus are well known for their morphological variability and chemical complexity (Miadlikowska & Lutzoni 2000). These two characteristics taken together have given the genus a reputation as taxonomically difficult and have obscured a remarkable degree of biological diversity. This diversity has begun to be uncovered as a direct result of a multifaceted approach to species circumscription that involves the correlation of molecular characters to so called “traditional” characters of biogeography, chemistry, ecology, and morphology (Goffinet and Miadlikowska 1999; Miadlikowska et al. 2003; O'Brien et al. 2009).

One of the thirty seven species of *Peltigera* that have been reported from North America is the aquatic *P. hydrothyria* Miadlikowska & Lutzoni (syn. *Hydrothyria venosa* J.L. Russell), a species so unusual in morphology and ecology that it was originally described in its own genus and considered unrelated to *Peltigera* (Russell 1856). Because of its aquatic habit and narrow ecological requirements the species has been the subject of considerable study with respect to potential anthropogenic threats and conservation issues (see summary by Poulsen and Carlberg (2007)). Despite its ecological significance and isolated position within *Peltigera* s.l. (Miadlikowska & Lutzoni 2000) there has neither been a modern taxonomic revision of *P. hydrothyria* nor an attempt to determine if the allopatric, chemically distinct populations from western North America (Feige et al. 1989) represent the same taxon. We undertook the present study to answer this question and our results are presented here.

MATERIALS AND METHODS

Fieldwork and herbarium materials

The first author undertook fieldwork in eastern (Pennsylvania) and western (California) North

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America to observe populations of *Peltigera hydrothyria* in person and study their ecologies. Additional fieldwork in Pennsylvania was carried out by other members of the Bryophyte and Lichen Technical Commission (BLTC) of the Pennsylvania Biological Survey (PABS). The specimens used in the molecular portion of this study were obtained through the collection efforts of the authors as well as through the generosity of numerous lichenologists and botanists in the geographically diverse regions where *P. hydrothyria* s.l. occurs. Voucher specimens that were used to generate all sequences used in this study have been deposited in the herbarium of The New York Botanical Garden (NY). We also examined the full holdings of *P. hydrothyria* s.l. at BUF, NY; and selected specimens from WTU.

Morphological and chemical methods

All specimens were studied dry using a Bausch & Lomb StereoZoom 7 dissecting microscope. Representative specimens were also subjected to chemical analysis using standard spot tests (reagents are abbreviated following Brodo et al. (2001)) and Thin Layer Chromatography (TLC). Thin Layer Chromatography was carried out on hand pulverized samples of the thallus ~1 cm² in size, extracted in acetone at room temperature, and run using solvent systems A and C following the standardized methods of Culberson and Kristinsson (1970). This procedure essentially follows the methodology for preparing samples outlined by Feige et al. (1989) except that liquid nitrogen was not used during pulverization. A sample of *Lobaria linita* (Ach.) Rabenh. was used as a standard initially to confirm the presence of methylgyrophorate.

Molecular Methods

Ten specimens from eastern North America (Pennsylvania and Virginia) and 11 from western North America (ranging from Alaska to California) were selected for molecular phylogenetic analyses. The Internal Transcribed Spacer (ITS) of the nuclear ribosomal RNA gene cluster was amplified and sequenced using the primers ITS1F (Gardes & Bruns 1993) and ITS4 (White et al. 1990), following the methods from O'Brien et al. (2009). Sequences were assembled using Sequencher 4.5 (Gene Codes, Ann Arbor, MI, USA) and manually aligned using MacClade 4.0 (Maddison & Maddison 2000). An initial phylogenetic analysis that included a single representative of each of the 7 other *Peltigera* sections recognized by Miadlikowska and Lutzoni (2000) as outgroups was carried out to confirm that all sequences from *P. hydrothyria* formed a monophyletic group. Due to the rapid sequence divergence of the ITS region this analysis required the exclusion of 313 of 692 alignment positions which could not be unambiguously aligned. A second phylogenetic analysis was therefore carried out on only *P. hydrothyria* sequences, but with all alignment positions included.

All phylogenetic analyses were carried out using the maximum parsimony criterion as implemented in PAUP* 4.0b10 (Swofford 2003). Branch support was assessed using bootstrapping with 1000 replicates. All searches were conducted the branch and bound search algorithm. Pairwise sequence similarity among *P. hydrothyria* sequences was calculated using the CLC Genomics Workbench (CLC Bio, Århus, Denmark), including indel characters. All sequences were deposited in GenBank (see table 1 in the appendix).

RESULTS AND DISCUSSION

As presently circumscribed *Peltigera hydrothyria* comprises two chemotypes, one in which the thalli produce methyl gyrophorate and one in which no substances are can be detected by TLC (Brodo et al. 2001). The former chemotype is restricted to the Appalachian Mountains and their outliers in eastern North America while the latter is widely distributed in the mountain ranges of western North America (e.g., Cascades, Coastal Range, Rocky Mountains, and Sierra Nevada). Considering this strong correlation between chemistry and biogeography we were curious if these allopatric populations were actually conspecific.

In order to answer this question we generated 21 ITS nrDNA sequences from specimens collected throughout the range of *Peltigera hydrothyria* (10 from eastern populations and 11 from western populations). Our analyses revealed the existence three distinct sequence types (Figure 1); one corresponding to the eastern North American populations and two corresponding to those from western North America. All ITS sequences generated from the eastern North American populations were 100% identical to each other. Of the two distinct ITS sequence types recovered from western North American populations, one was comprised of seven accessions from California, Oregon, and Washington while the

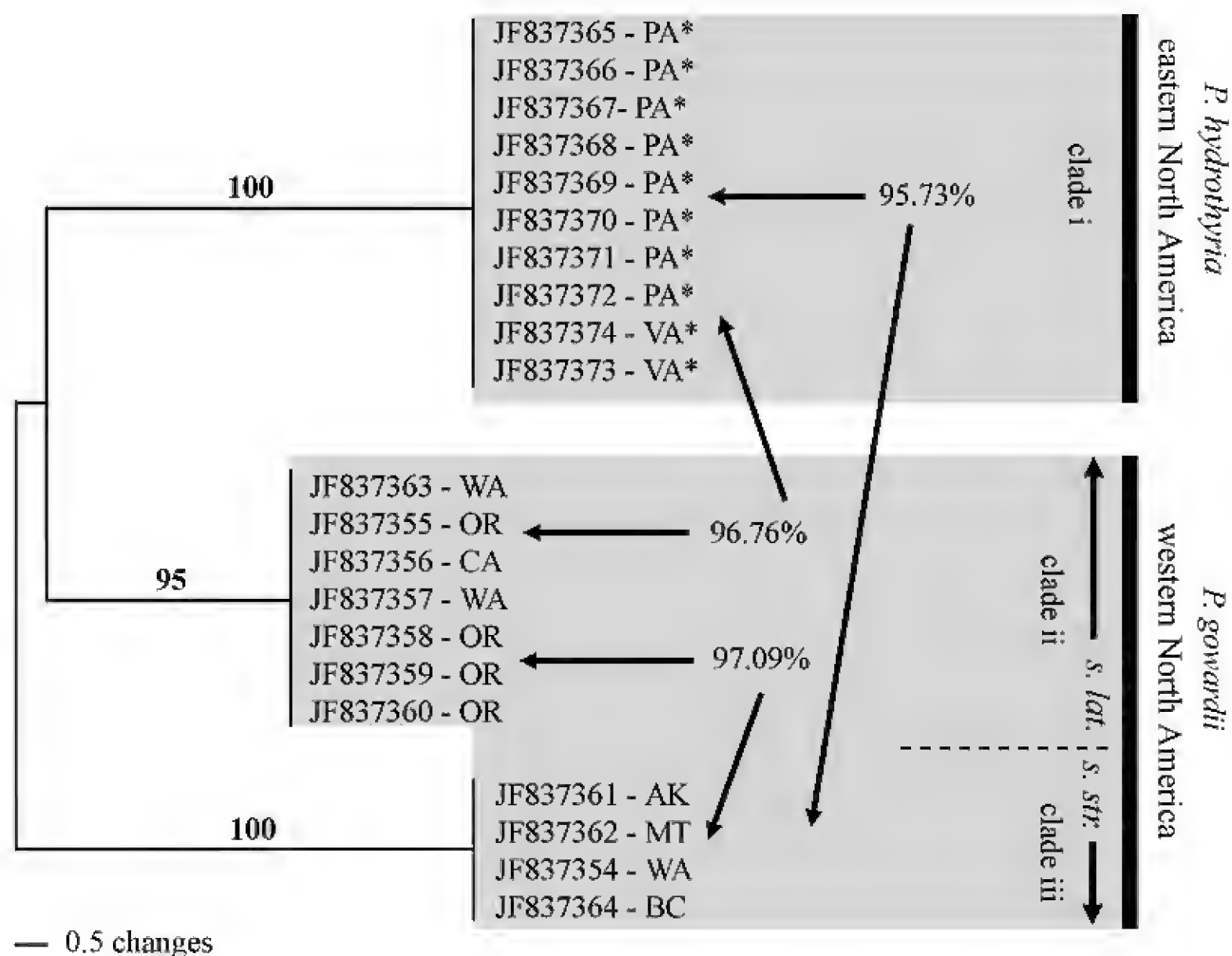


Figure 1. Phylogeny of *Peltigera hydrothyria* s.l. with midpoint rooting, inferred from ITS1, 5.8S, and ITS2 sequence data using unweighted maximum parsimony (MP), with gaps excluded. MP-bootstrap proportions are shown above the branches. Percent similarity between sequence types (including gaps) is indicated by arrows. Shaded clades correspond to formally recognized taxa outlined on the right side of the figure.

second was comprised of four accessions from Alaska, British Columbia, Montana, and Washington. Bootstrap support was $\geq 95\%$ for each sequence type and pairwise similarity between sequence types was between 96% and 97% (Figure 1). In the analysis that included outgroups, monophyly of *P. hydrothyria* received 100% bootstrap support and the sequence type from eastern North America was weakly supported (66% bootstrap) as sister to the California/Oregon/Washington sequence type (results not shown). The divergence (4-5%) observed between the three groups of *Peltigera hydrothyria* sequences generated for this study is unusually high for intraspecific variation in lichenized ascomycetes (Nilsson et al. 2008). In fact it corresponds well to that observed between sister species of Ascomycota (Nilsson et al. 2008), as well as divergence levels observed between other related *Peltigera* species (O'Brien et al. 2009). Furthermore, the absence of any polymorphism within lineages indicates that the divergence is not due to accelerated sequence evolution within this group. The formation of such discontinuous clusters is highly improbable within a single interbreeding species and is considered diagnostic of species boundaries (Mallet 1995). Thus molecular characters strongly suggest that three species are included in *P. hydrothyria* as presently circumscribed.

HOW MANY SPECIES SHOULD WE RECOGNIZE?

Peltigera hydrothyria presents a case where three sets of characters each result in different species delimitation: morphological characters support a single disjunct species, chemical analysis supports two morphologically cryptic allopatric species, and molecular data support three species including two with identical chemistry and overlapping ranges (figure 2). The question of how best to reconcile the results of

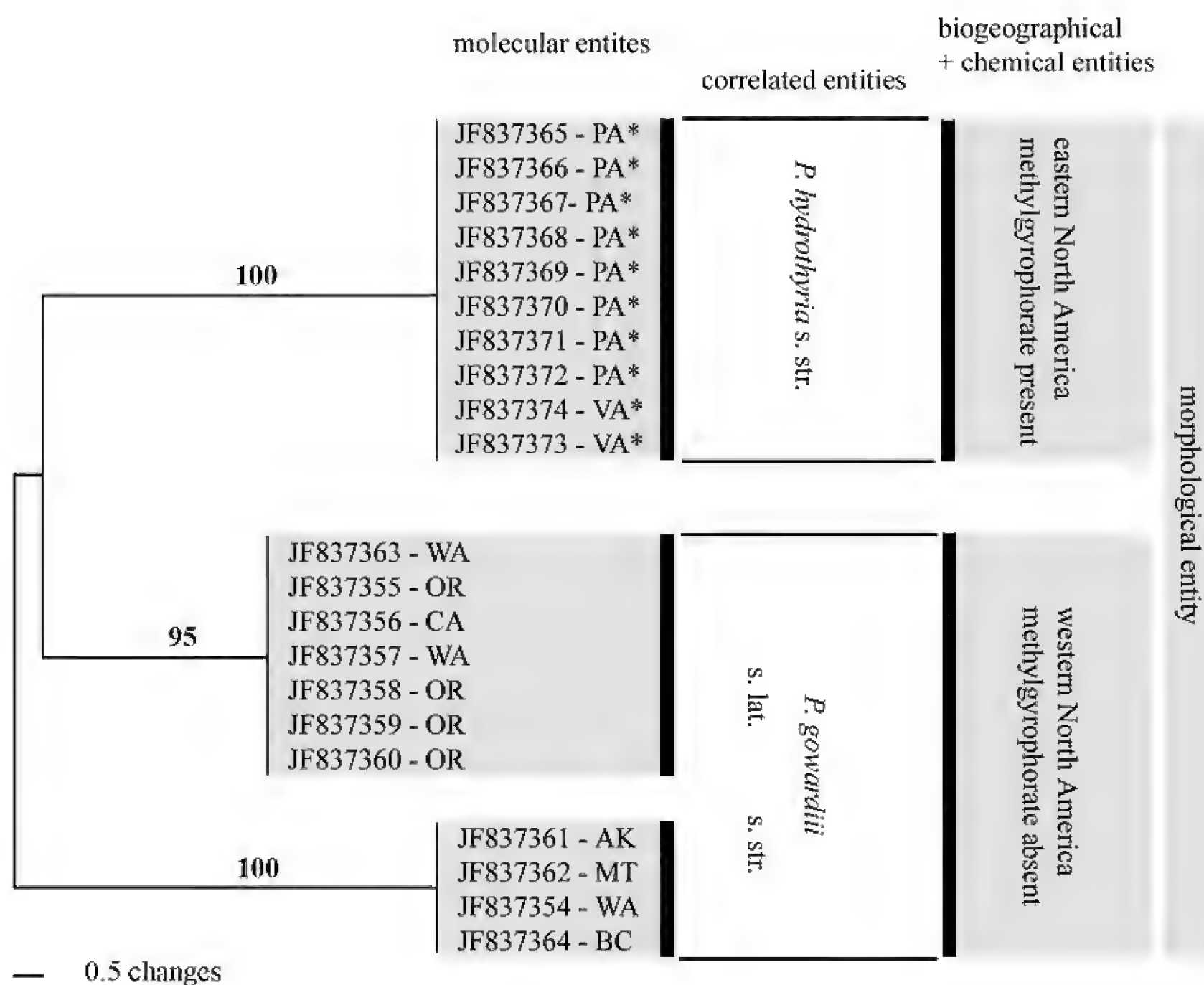


Figure 2. Inferred phylogeny from figure 1 with entities supported by different types of characters superimposed (molecular characters shaded left; biogeographical + chemical characters shaded middle right; morphological entity shaded far right). Correlated entities formally recognized here are shown in the middle.

analyses of molecular versus non-molecular (e.g., biogeographic, chemical, ecological, and morphological) datasets has received increasing attention in lichenology during the last decade (Crespo & Lumbsch 2010, Crespo & Pérez-Ortega 2009; Grube & Kroken 2000; Hodkinson & Lendemer 2011; Lendemer in press.). This trend is tied directly to the fact that studies of lichens, taxonomic or otherwise, increasingly incorporate analyses of molecular data. This has resulted in the discovery of numerous examples where evolutionary history inferred from sequence data does not perfectly correspond to, or entirely contradicts, current taxonomic concepts.

In many cases, careful reevaluation of non-molecular characters in light of the results obtained from molecular phylogenetic analyses reveals previously overlooked or underemphasized characters that actually resolve the conflict initially observed between datasets. These previously overlooked or underemphasized characters can be morphological, chemical, ecological, biogeographical or, as is more often the case, some combination thereof (Argüello et al. 2007; Divakar et al. 2007; Hodkinson & Lendemer 2011; Lendemer in press.; Lendemer & Hodkinson 2009, 2010; Vondrák et al. 2009). When reevaluation does not lead to the discovery of such correlated characters resolution is more difficult because one must make an informed decision to choose to emphasize some characters over others. This process is identical to historical taxonomic methodologies, differing only by the inclusion of molecular characters. Thus, despite its modern context the conundrum faced by one attempting to resolve conflict between molecular and non-molecular datasets is no different from that experienced decades ago when thin-layer

chromatography became commonplace, or centuries ago when developments in optics allowed scientists to observe ascospores in detail for the first time.

In this case, chemistry, biogeography and molecular data are all in agreement in rejecting the current circumscription of *Peltigera hydrothyria* based on morphology. It was therefore deemed to be necessary to describe at least one new species to accommodate the western populations. The number of new species needed to accommodate these populations is less obvious, however. Clearly the two western ITS lineages represent cryptic species in the sense of most recent authors (see summary in Lendemer (in press.)) because they can only be recognized using molecular characters. It could be argued that the morphological and chemical characters do not contradict the molecular data but simply lack the sensitivity to distinguish closely related species. However, it is also possible that the divergence in the ITS locus represents a case of extreme intraspecific divergence within interbreeding populations.

There is a biogeographic trend within the western lineages, with one lineage being collected from more northern sites (Washington northward) while the other was collected from southern sites (Washington southward). Representatives of both lineages do occur along the same trail in the Mt. Baker-Snoqualmie National Forest in Snohomish County, Washington (*Joneson 3839* and *Joneson 3840*, both in WTU). Thus the ranges of the two lineages overlap in Washington. Additional sampling would be required to confirm this pattern and to determine the extent of overlap. Genotyping of additional unlinked molecular markers would also be required to determine if there is interbreeding between specimens represented by the different ITS lineages. The rooting presented in Figure 1 implies that the western lineages are paraphyletic as one of them is more closely related to the eastern lineage than it is to the other western lineage, but this relationship was not strongly supported, so we cannot rule out the possibility that the western populations are monophyletic. Inclusion of additional loci that can be reliably aligned across the genus will be needed to resolve this issue. In the absence of these additional data we believe the most prudent solution to this problem is the formal recognition of two species, one of which is broadly defined to include an additional cryptic taxon. A taxonomic treatment of these taxa is provided below.

TAXONOMIC SECTION

1. *Peltigera gowardii* Lendemer & H. O'Brien sp. nov.

Mycobank #561541.

FIGURE 3 (PAGE 104).

Ab Peltigera hydrothyria (GenBank JF837365) distributione geographica in America occidentale non America orientale, acido methylglyphorico et acid methyllecanorico destituto, et synapomorphis molecularibus in acido desocyribonucleinico nrITS ab aliis adenio ad positiones 206, 207, et 485, cystosino ad positiones 131 et 144, guanino ad positionem 415, thymino ad positionem 151, et nullo ad positionem 216 (GenBank JF837364) differt.

TYPE: **CANADA. BRITISH COLUMBIA:** Trophy Mountains, 22 km ENE of Clearwater Village, 51°47'N, 119°53'W, 1050 m., open sunny meadow, saxicolous in small stream, 5.ix.2009, *T. Goward s.n.* (NY, holotype; B, DUKE, H, GZU, hb. Kalb, isotypes).

DESCRIPTION. – Thallus foliose, forming small rosettes of variable size attached to the substrate by one to several holdfasts, black when wet, slate gray to black when dry, without soredia, isidia, lichenized diaspores, or rhizines, thin and papery when dry (~100 µm thick) lobes 0.5-1 cm broad, plane with ruffled margins; upper surface smooth, dull, epruinose, glabrous; lower surface smooth, dull, as for the upper surface except for the presence of distinct white veins composed of parallel and conglutinated hyphae; cortex paraplectenchymatous, thin, hyaline, ~8-10 µm thick; photobiont layer and medulla not distinct (e.g., thallus unstratified), 140-160 µm thick composed of loosely woven prosoplectenchymatous hyphae (4-6 µm thick) and photobiont cells; apothecia reddish-brown, submarginal, sessile; asci 8-spored; ascospores hyaline, clavate-fusiform, 3-septate, 24-29-33 x 6.6-7.2-7.8 µm (n=40), unornamented. Photobiont: *Nostoc*.

CHEMISTRY. – No lichen substances detected (for additional discussion see the chemistry section under *Peltigera hydrothyria*). Spot tests: K-, C-, KC-, P-, UV-.

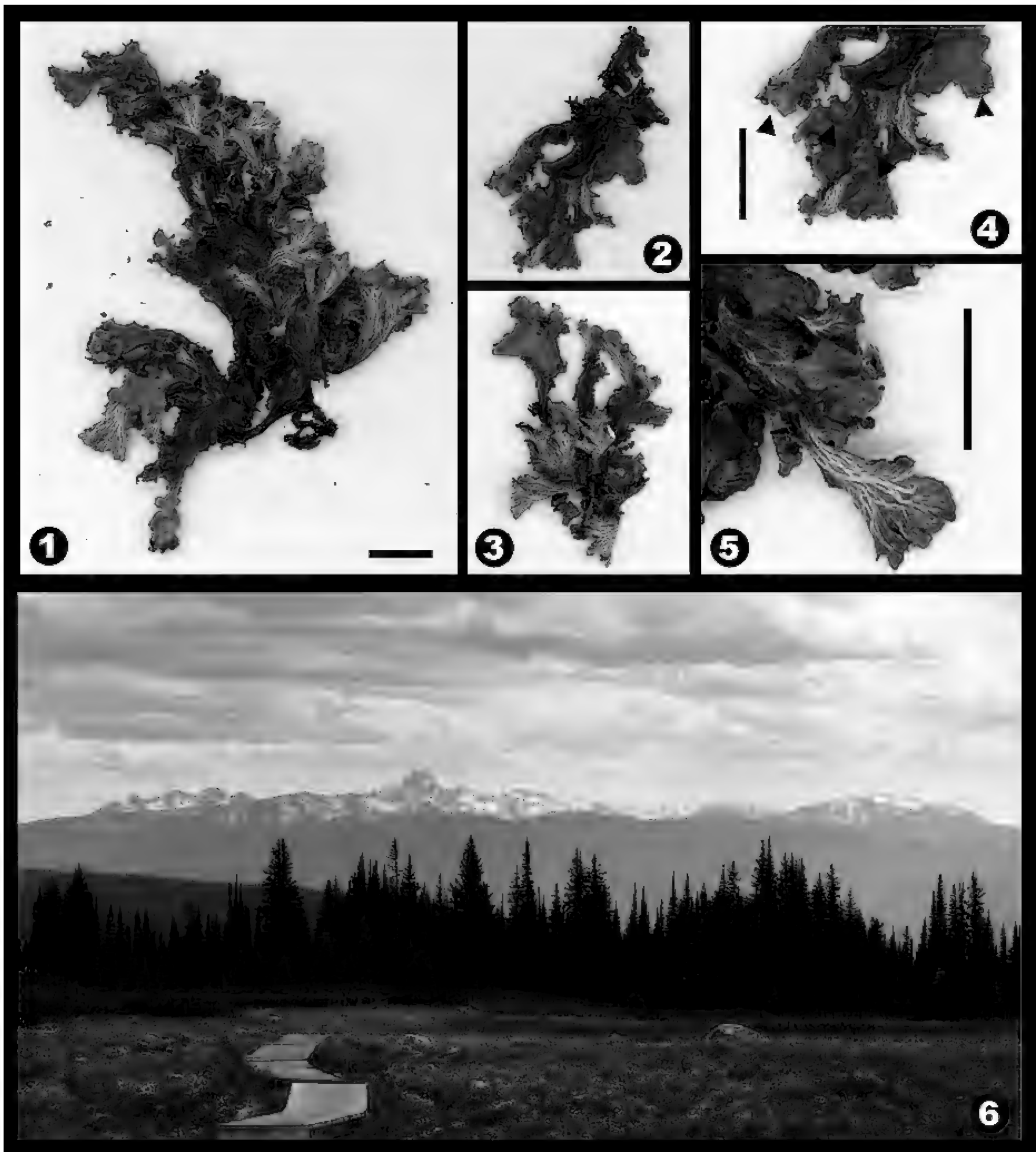


Figure 3. *Peltigera gowardii* (Figures 1-5 from Shevock 31722, NY; scale bars = 1 cm). Figures 1-3, macro-morphology of the thallus (scale is same for all three figures). Figure 4, detail of thallus illustrating subterminal position of the apothecia (arrows). Figure 5, detail of underside and veins. Figure 6, type locality.

ETYMOLOGY. – The new species is dedicated to Trevor Goward, collector of the type and lichenologist in the Pacific Northwest of North America where the species occurs.

COLOR ILLUSTRATION. – Brodo et al. (2001: 342, pl. 369), figure 3 herein.

ECOLOGY AND DISTRIBUTION. – As circumscribed here *Peltigera gowardii* is widely distributed in the mountain ranges of northwestern North America (fig. 5, right). Extending from central/northern California northward to Oregon, Washington, and British Columbia with disjunct populations in Idaho and southern Alaska. Further study is needed to determine whether the species is present elsewhere in British Columbia and Alaska.

The ecology of *Peltigera gowardii* in the central part of its range was studied in detail by Glavich (2009) whose conclusions are summarized here. That author found that the species was significantly associated with both older forests and non-key watersheds, indicating that conservation/management of this species will not be effective if only key watersheds are considered. Although the species was found on all sizes of rocks it was most frequently encountered on large rocks and bedrock in shade approximately 0-2 cm above water level. Of the three aquatic macrolichens studied by Glavich (2009) *P. gowardii* had the narrowest confidence interval for water quality.

DISCUSSION. – *Peltigera gowardii* is essentially the western equivalent of *P. hydrothyria*, differing from that species only in the absence of secondary compounds and allopatric distribution. As has been summarized in the preceding section, *P. gowardii* as circumscribed here comprises two distinct lineages with differing biogeographic tendencies. Further study is needed to determine whether these tendencies actually represent discrete differences that could be used to justify further taxonomic division of *P. gowardii* into its constituent phylogenetic entities. One clear implication of the formal recognition of *P. gowardii* is the need to reevaluate conservation and management status of this western North American endemic.

SELECTED SPECIMENS EXAMINED. – **U.S.A. ALASKA.** Denali National Park and Preserve, Skihi Creek Watershed, 31.viii.2007, *J.K. Walton 10362* (NY). **CALIFORNIA.** MADERA CO.: Sierra National Forest, Brown's Creek near intersection with FS 8509, 6.VII.2004, *B.D. Ryan 32035* (NY); Sierra National Forest, tributary to Sand Creek, 21.ix.1985, *C. Bratt 4757* (NY). MARIPOSA CO.: Yosemite National Park, headwaters of Staircase Falls Stream just below Glacier Point, 15.x.2006, *J.R. Shevock 29110* (NY); Mariposa, viii.1866, *H.N. Bolander s.n.* = *Rel. Tuck. 52* (NY). TRINITY CO.: Shasta-Trinity National Forest, in Collins Creek, 13.vii.2002, *L. Wisheart s.n.* (NY). TULARE CO.: Sequoia National Forest, W slope of Slate Mountain, 11.vii.1999, *J. Shevock 18432* (NY). **MONTANA.** MISSOULA CO.: North Fork Falls, 14.vii.2005, *T. Wheeler 877* (NY). **OREGON.** DOUGLAS CO.: Umpqua National Forest, in Camas Creek, 11.ix.2009, *D. Glavich s.n.* (NY). LANE CO.: Mule Prairie, 19.ix.1945, *M. Doty 6921* (NY); above Salt Creek Falls, 20.ix.1942, *M. Doty 5272* (NY); Ridge Creek, Cougar Reservoir, 17.ii.2007, *D. Glavich & L. Geiser s.n.* (NY). **WASHINGTON.** CLARK CO.: Gifford-Pinchot National Forest, in Bolin Creek, 29.viii.2002, *M. Nadel s.n.* (NY). LEWIS CO.: Gifford Pinchot National Forest, head of Wobbly Creek S of FS 7807, 14.ix.2000, *J. Riley s.n.* (NY). PIERCE CO.: Mt. Rainier, Berkeley Park, 18.vii.1931, *G.E. Howard 612* (NY). SNOHOMISH CO.: Mt. Baker-Snoqualmie National Forest, Meadow Mt. Trail, FS 2710, 9.ix.2002, *S. Joneson 3839* (WTU); Mt. Baker-Snoqualmie National Forest, Meadow Mt. Trail, Glacier Peak Wilderness Area, 11.ix.2002, *S. Joneson 3840* (WTU). **CANADA. BRITISH COLUMBIA.** Trophy Mountains, 22 km ENE of Clearwater Village, 14.x.2005, *T. Goward s.n.* (NY).

2. *Peltigera hydrothyria* Miadlikowska & Lutzoni, Int. Jour. Plant Sci., 161(6): 949. 2000. *nom. nov. pro. Hydrothyria venosa* J.R. Russell *non P. venosa* (L.) Hoffm.

Hydrothyria venosa J.R. Russell, Proc. Essex Inst. 1: 188. 1856. TYPE: **U.S.A. NEW HAMPSHIRE.** CHESHIRE CO.: in rivulets from Wantasquit Mt., Brattleboro, 16.vii.1851, *J.L. Russell s.n.* = *Rel. Tuck. 51* (NY[-ANDERSON]!, lectotype **designated here**; NY!, NY[-DEPAUW]!, isoelectotypes).

Leptogium fontanum J.R. Russell *ex Tuck. nom. nud.*, Lich. Amer. Sept. Exs., V/VI: 150. 1854. ORIGINAL MATERIAL: “Ad saxa aqua plerumque suffusa in rivulis montium Novae Angliae detexit cl. Russell”.

FIGURE 4 (PAGE 106).

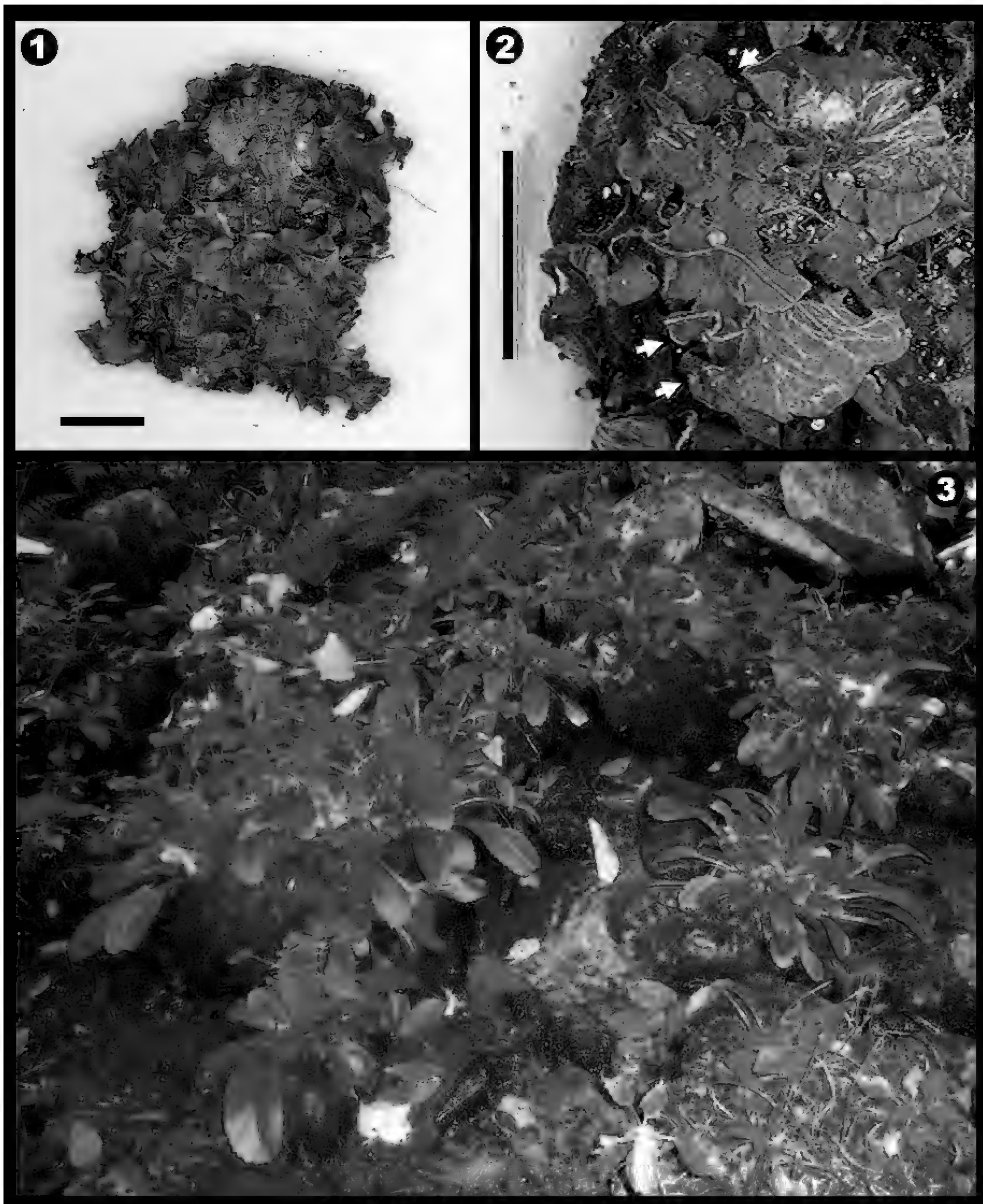


Figure 4. *Peltigera hydrothyria* (Figures 1-2 from *Buck 25150*, NY; scale bars = 1 cm). Figure 1, macromorphology of thallus. Figure 2, detail of thallus illustrating underside with veins, and upper surface with subterminal apothecia (arrows). Figure 3, typical habitat (Sweet Root Gap, Bedford Co., Pennsylvania; photo by J. Kunsman).

Nomenclatural Comments – The currently accepted name for this taxon, *Peltigera hydrothyria*, was established by Miadlikowska and Lutzoni (2000) when transferring it to the genus *Peltigera* Willd. because the epithet “venosa” was already occupied by *P. venosa* (L.) Hoffm. The taxon was originally described under the name *Hydrothyria venosa* by Russell (1856). Prior to the publication of the name *H. venosa*, Russell apparently experimented with the use of the epithet “fontana” for the species, as is evidenced by his handwritten notes on specimens distributed to his botanical contemporaries (BUF!).

Russell also sent specimens of the species to Edward Tuckerman who distributed them in 1854 as part of his *Lichenes Americanae Septentrionalis Exsiccati* under the name “*Leptogium fontanum* Russell”. This latter name is a *nomen nudum* because though effectively published by Tuckerman (1854) it lacks a validating description or illustration. Tuckerman (1854) also included a reference to a description of *Hydrothyria* in 1853 by Russell (“Russ. in Trans. Ess. Inst. 1853”), however while Russell’s report was read at a meeting of the Essex Institute in 1853 it was not actually published until 1856.

Typificational Comments – Despite being the subject of considerable study, the name *Hydrothyria venosa* does not appear to have been previously typified. At the time of its description Russell did not designate a type or refer to a single specimen or gathering thus we assume the name is based on a suite of syntypes because material was distributed by Tuckerman two years prior to the date of valid publication of the same (see above). Since no previous authors appear to have selected a lectotype (or effectively select a lectotype by reference to a holotype) we have done so here. We chose a collection distributed in the *Reliquiae Tuckermanianae* as the lectotype because it is widely distributed in herbaria, has a date of collection prior to the publication of the protologue, and because it was referred to as the “Type collection” on the printed exsiccati label. Numerous additional specimens collected and distributed by Russell have been seen in the course of our study and some of them may represent duplicates of the collection selected here as the lectotype. Many of these specimens however have incomplete collection data and cannot conclusively be linked to the type collection.

The original material of *Hydrothyria venosa* is often referred to as having been collected in Vermont because the labels refer to the town of Brattleboro in Windham County, VT. As was recently pointed out by Dorothy Allard (pers. comm.) the type locality, Wantasquit Mountain, is actually situated in Cheshire County, New Hampshire on east side of the Connecticut River which divides New Hampshire and Vermont. This corrected locality data is reflected in the synonymy above.

Description. – As for the preceding species.

Chemistry. – Methylgyrophorate, methylecanorate, \pm traces of gyrophoric or lecanoric acid. Spot tests: K-, C-, KC-, P-, UV-.

Feige et al. (1989) studied the chemistry of five samples of *Peltigera hydrothyria* s.l., three from eastern North America (= *P. hydrothyria* s. str.) and two from western North America (= *P. gowardii*) using high performance liquid chromatography (HPLC). Those authors detected methylgyrophorate with accessory methylecanorate in the three specimens of *P. hydrothyria* s. str. while they did not detect those substances in the two samples of *P. gowardii*. This appears to be the basis of the subsequent reports of two chemotypes in *P. hydrothyria* s.l. by Miadlikowska and Lutzoni (2000) as well as Brodo et al. (2001).

Brodo et al. (2001) noted that although lichen substances were present in *P. hydrothyria* s.l. they were not detectable using standard spot tests. We thus attempted to detect these substances using routine thin layer chromatography (TLC). Using solvent system A and *Lobaria linita* as a standard for methylgyrophorate we were initially unable to detect any lichen substances in representative specimens of *P. hydrothyria* s.l. Subsequently we reanalyzed new samples from the same specimens using solvent system C and the same standard. With this approach we were able to detect the substances in the majority of the representative specimens of *P. hydrothyria* s. str. examined, including the lectotype. It should also be noted that in two specimens examined accessory gyrophoric acid was also detected and the acetone extracts were C+ pink. While no lichen substances were detected in the representative specimens of *P. gowardii* that were examined, including the holotype, the same result was obtained for several additional specimens of *P. hydrothyria* s. str. including two isoelectotypes. Suspecting that the substances may be present only in low concentrations we again analyzed new samples from these specimens and were finally able to detect the presence of the lichen substances. Based on these results it is likely that methylgyrophorate and methylecanorate are present in variable concentrations within and between thalli of *P. hydrothyria* s. str., and this not always easily detected with routine methods of chemical analysis (i.e.

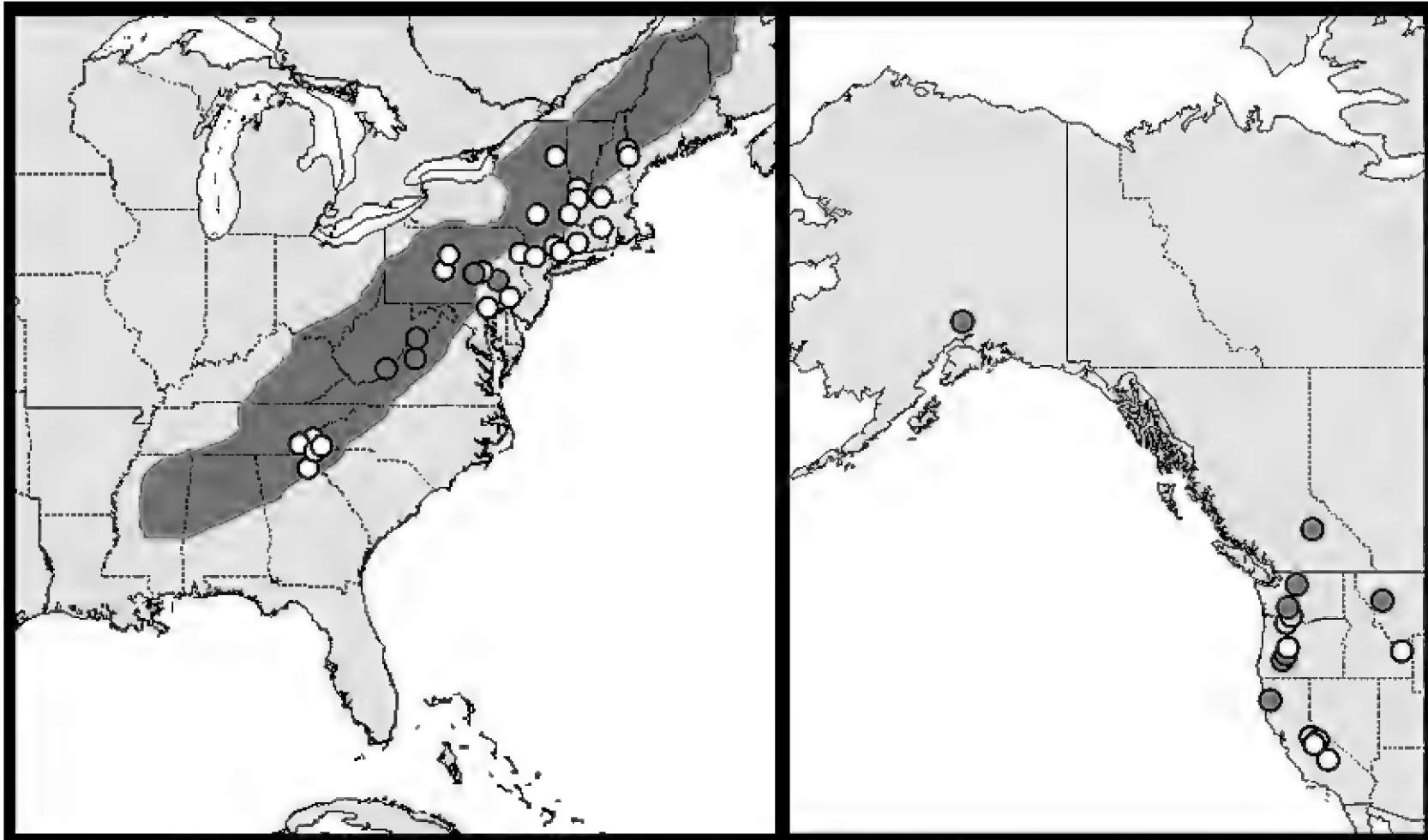


Figure 5. Geographic distributions of *Peltigera gowardii* (right) and *P. hydrothyria* (left, shaded region approximates the Appalachian Mountains) based on specimens examined as part of the present study. Circles filled with color correspond to the clades recovered in the molecular phylogenetic analyses (green = clade i, red = clade ii, and yellow = clade iii).

spot tests and TLC). Though not practical within the scope of this study we strongly suggest that any future study of *P. hydrothyria* s.l. include detailed analysis of a broad sampling of specimens with HPLC.

Color illustrations. – Figure 4, herein.

Ecology and Distribution. – *Peltigera hydrothyria* as circumscribed here is endemic to the Appalachian Mountains and their outliers in eastern North America (fig. 5, left). The ecology of this species has not been studied in detail, however field observations (Dennis et al. 1981; Stabley unpublished data) indicate that habitat requirements of this taxon are comparable to those of *P. gowardii*.

Discussion. – *Peltigera hydrothyria* is morphologically identical to *P. gowardii*, differing only in its allopatric distribution and the production of methylgyrophorate and methylecanorate. These differences, which are supported by the results of the molecular phylogenetic analyses carried out for this study strongly support the restricted concept of *P. hydrothyria* employed here. While the ecology of *P. gowardii* has been studied in detail, that of *P. hydrothyria* has not. Thus one immediate and significant implication of the restriction of *P. hydrothyria* to eastern North American populations is the need for detailed ecological studies to determine the conservation and management needs of this taxon. Informal field studies carried out in Pennsylvania during the last decade indicate that populations of this taxon may be experiencing decline in that region. Potential reasons for this include alteration of terrestrial habitats (i.e., lack of maintenance of forested buffers along waterways where the species occurs) and deterioration of water quality. Although both factors are ongoing issues in eastern North America the potential impact of natural gas extraction via hydraulic fracturing on water quality as it relates to *P. hydrothyria* requires immediate study. Formal studies are required to evaluate these observations as well and establish benchmark data on populations of this taxon throughout its range.

SELECTED SPECIMENS EXAMINED. – **U.S.A. CONNECTICUT.** LITCHFIELD CO.: Kent, 13.x.1925, G.P. Anderson s.n. (NY). NEW HAVEN CO.: Mt. Carmel, 29.v.1893, D.C. Eaton s.n. = Dec. N. Amer. Lich. 691 (NY). **GEORGIA.** WHITE CO.: Unicoi State Park, 18.v.1976, W.R. Buck 1299 (NY). **MAINE.** OXFORD CO.: White Mountains National Forest, Batchelders Grant, 17.vi.2007, B. Allen 28312 (NY). **MASSACHUSETTS.** BERKSHIRE CO.: Town of Florida, Reed Brook TNC Preserve, 7.v.1995, R.C. Harris 36559 (NY). **NEW HAMPSHIRE.**

CHESIRE CO.: Mt. Monadnock, 17.viii.1908, *R.H. Howe Jr s.n.* (NY). COOS CO.: Ingalls Brook, Shelburne, 2.ix.1886, *E. Faxon s.n.* (NY). **NEW JERSEY**. BERGEN CO.: Closter, sine date, *C.F. Austin 150* (NY). PASSAIC CO.: Myanokie Lodge Brook, 15.iv.1923, *G.P. Anderson s.n.* (NY). **NEW YORK**. ESSEX CO.: Newcomb, 31.viii.1934, *J.L. Lowe 5027* (NY). ROCKLAND CO.: Torne Brook E of Sloatsburg, 3.vii.1924, *A.T. Beals s.n.* (NY). ULSTER CO.: Frost Valley, along High Falls Creek, 12.v.1980, *R.C. Harris 13314* (NY). **NORTH CAROLINA**. MACON CO.: Nantahala National Forest, Winding Stair Gap, in Moore Creek, 9.x.1998, *W.R. Buck 34979* (NY). SWAIN CO.: Great Smoky Mountains National Park, N of Smokemont Campground, 16.v.1976, *R.C. Harris 11022* (NY). **PENNSYLVANIA**. BERKS CO.: old Birdsboro Reservoir, sine date, *S. Munch s.n.* (NY). CENTRE CO.: Schalls Gap, 14.vi.1983, *B. Allen 3322* (NY). CLINTON CO.: Mill Branch Run, 19.vii.1994, *B. Allen 15978* (NY). DAUPIN CO.: State Game Lands No. 210, 10.iii.2007, *J.C. Lendemer 10-02-07-02 & J.R. Stabley* (NY). HUNTINGDON CO.: Pa. State Nature Camp, 21.vii.1938, *J.W. Thomson s.n.* (NY). MONROE CO.: Buck Hill Falls, 12.vii.1927, *J.F. Lewis s.n.* (NY). PHILADELPHIA CO.: Wissahickon, xi.1885, sine collector (NY). **TENNESSEE**. MONROE CO.: Cherokee National Forest, Citico Creek Wilderness, 6.viii.1994, *W.R. Buck 25180* (NY). **VERMONT**. WINDHAM CO.: Stratton, vi.1935, *A.J. Grout s.n.* (NY). **VIRGINIA**. ALLEGHANY CO.: tributary to Simpson Creek at Rt. 70, 23.x.2007, *F. Huber & D. Krik s.n.* (NY). AMHERST CO.: N of Floyd Mt., 28.ix.2007, *F. Huber & D. Kirk s.n.* (NY). GILES CO.: Jefferson National Forest, Little Stony Creek, 28.viii.2007, *F. Huber & D. Kirk s.n.* (NY). SHENANDOAH CO.: upper E slope of Devil's Hole Mt., 1.v.1938, *H.A. Allard 4601* (NY).

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LITERATURE CITED

- Argüello A., R. del Prado, P. Cubas and A. Crespo. 2007. *Parmelia quercina* (Parmeliaceae, Lecanorales) includes four phylogenetically supported morphospecies. *Biological Journal of the Linnean Society*, 91: 455–467.
- Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven, London. 795 pp.
- Crespo, A. and H.T. Lumbsch. 2010. Cryptic species in lichen-forming fungi. *IMA Fungus*, 1(2): 167–170.
- Crespo A, and S. Pérez-Ortega. 2009. Cryptic species and species pairs in lichens: a discussion on the relationship between molecular phylogenies and morphological characters. *Anales del Jardín Botánico de Madrid*, 66S1: 71–81.
- Culberson, C.F., and H. Kristinsson. 1970. A standardized method for the identification of lichen products. *Journal of Chromatography*, 46: 85–93.
- Dennis, W.M., P.A. Collier, P. DePriest, E.L. Morgan. 1981. Habitat notes on the aquatic lichen *Hydrothyria venosa* Russell in Tennessee. *The Bryologist*, 84: 402–403.
- Divakar P.K., M.C. Molina, H.T. Lumbsch and A. Crespo. 2005. *Parmelia barrenoae*, a new lichen species related to *Parmelia sulcata* (Parmeliaceae) based on molecular and morphological data. *Lichenologist*, 37(1): 37–46.
- Esslinger, T.L. 2010. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: <http://www.ndsu.edu/pubweb/~esslinge/chcklst/chcklst7.htm> (First Posted 1 December 1997, Most Recent Version (#16) 18 June 2010), Fargo, North Dakota.
- Feige, G.B., M. Geyer and G. Follmann. 1989. Erster Nachweis flechtenspezifischer Sekundärstoffe in der aquatischen 'Gallertflechte' *Hydrothyria venosa* Russ. *Herzogia*, 8: 69–75.
- Gardes, M. and T.D. Bruns. 1993. ITS primers with enhanced specificity for basidiomycetes - application to the identification of mycorrhizae and rusts. *Molecular Ecology*, 2: 113–118.
- Glavich, D.A. 2009. Distribution, rarity and habitats of three aquatic lichens on federal land in the U. S. Pacific Northwest. *The Bryologist*, 112(1): 54–72.
- Goffinet, B. and J. Miadlikowska. 1999. *Peltigera phyllidiosa* (Peltigeraceae, Ascomycotina), a new species from the southern Appalachians corroborated by ITS sequences. *The Lichenologist*, 31: 247–256.
- Grube M and S. Kroken. 2000. Molecular approaches and the concept of species and species complexes in lichenized fungi. *Mycological Research*, 104: 1284–1294.
- Hodkinson B.P. and J.C. Lendemer. 2011. Molecular analyses reveal cryptic species in *Xanthoparmelia tasmanica*. *Bibliotheca Lichenologica*, 106: 108–119.
- Lendemer, J.C. In press. A taxonomic revision of the North American species of *Lepraria* s.l. that produce divaricatic acid, with notes on the type species of the genus *L. incana*. *Mycologia*.
- Lendemer, J.C. and B.P. Hodkinson. 2009. The wisdom of fools: new molecular and morphological insights into the North American apodetiate species of *Cladonia*. *Opuscula Philolichenum*, 7: 79–100.
- Lendemer, J.C. and B.P. Hodkinson. 2010. A new perspective on *Punctelia subrudecta* (Parmeliaceae) in North America: previously rejected morphological characters corroborate phylogenetic hypotheses and provide

- insight into an old problem. *The Lichenologist*, 42(4): 405-421.
- Maddison, D.R. and W.P. Maddison. 2000. *MacClade 4: Analysis of phylogeny and character evolution*. Version 4.0. Sinauer Associates, Sunderland, MA.
- Mallet, J. 1995. A Species definition for the Modern Synthesis. *Trends in Ecology and Evolution*, 10:294-299.
- Miadlikowska, J. and F. Lutzoni. 2000. Phylogenetic revision of the genus *Peltigera* (lichen-forming Ascomycota) based on morphological, chemical, and large subunit nuclear ribosomal DNA data. *International Journal of Plant Science*, 161: 925-958.
- Miadlikowska, J., F. Lutzoni, T. Goward, S. Zoller, and D. Posada. 2003. New approach to an old problem: incorporating signal from gap-rich regions of ITS and rDNA large subunit into phylogenetic analyses to resolve the *Peltigera canina* species complex. *Mycologia*, 95: 1181-1203.
- Nilsson, R.H., E. Kristiansson, M. Ryberg, N. Hallenberg, and K.-H. Larsson. 2008. Intraspecific ITS variability in the the kingdom fungi as expressed in the international sequence databases and its implications for molecular species identification. *Evolutionary Bioinformatics*, 4: 193-201.
- O'Brien, H.E., J. Miadlikowska and F. Lutzoni. 2009. Assessing reproductive isolation in highly diverse communities of the lichen-forming fungal genus *Peltigera*. *Evolution*, 63:2076-2086.
- Poulsen, B. and T. Carlberg. 2007. *Peltigera hydrothyria*, sponsorship for the CALS Conservation Committee. *Bulletin of the California Lichen Society*, 14: 15-18.
- Russell, J.L. 1856. *Hydrothyria venosa*, a new genus and species of the Collemaceae. *Proceed. Essex Inst.*, 1: 88.
- Swofford, D.L. 2003. *PAUP*: Phylogenetic Analysis Using Parsimony (*and Other Methods)*. Version 4. Sinauer Associates Inc., Sunderland, MA.
- Tuckerman, E. 1854. *Lichenes Americanae Septentrionalis Exsiccati*, Fascicle V et VI. Wilson, Boston. 50pp.
- Vondrák J., P. Říha, U. Arup, and U. Söchting. 2009. The taxonomy of the *Caloplaca citrina* group (Teloschistaceae) in the Black Sea region; with contributions to the cryptic species concept in lichenology. *The Lichenologist*, 41: 571–604.
- White, T.J., T.D. Bruns, S. Lee, and J.W. Taylor. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics *in* M. A. Innis, D. H. Gelfand, J. J. Sninsky, and T. J. White, eds. *PCR Protocols: A Guide to Methods and Applications*. Academic Press Inc., New York, NY.

APPENDIX – GENBANK NUMBERS AND ASSOCIATED VOUCHER DATA FOR SEQUENCES USED IN THIS STUDY.

Table 1. GenBank numbers and associated voucher data for sequences used in this study.

Taxon	GenBank No.	Extract No.	Herbarium	Voucher	Locality
<i>P. gowardii</i> s. str.	JF837361	HV22	NY-01117829	<i>Walton 10362</i>	U.S.A. Alaska
<i>P. gowardii</i> s. str.	JF837362	HV13	NY-01117824	<i>Wheeler 877</i>	U.S.A. Montana
<i>P. gowardii</i> s. str.	JF837354	SLJ3840	WTU	<i>Joneson 3840</i>	U.S.A. Washington
<i>P. gowardii</i> s. str.	JF837364	HV08	NY-01117825	<i>Goward s.n.</i>	Canada. British Columbia
<i>P. gowardii</i> s.l.	JF837363	SLJ3839	WTU	<i>Joneson 3839</i>	U.S.A. Washington
<i>P. gowardii</i> s.l.	JF837355	HV17	NY-01117827	<i>Glavich s.n.</i>	U.S.A. Oregon
<i>P. gowardii</i> s.l.	JF837356	HV16	NY-01117823	<i>Wischart s.n.</i>	U.S.A. California
<i>P. gowardii</i> s.l.	JF837357	HV14	NY-01117828	<i>Nadel s.n.</i>	U.S.A. Washington
<i>P. gowardii</i> s.l.	JF837358	HV12	NY-01117826	<i>Nadel s.n.</i>	U.S.A. Oregon
<i>P. gowardii</i> s.l.	JF837359	HV19	NY-01117842	<i>Glavich s.n.</i>	U.S.A. Oregon
<i>P. gowardii</i> s.l.	JF837360	HV18	NY-01117843	<i>Glavich s.n.</i>	U.S.A. Oregon
<i>P. hydrothyria</i>	JF837365	HV01	NY-01117833	<i>Stabley 09-23-05-01</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837366	HV02	NY-01117834	<i>Stabley 09-23-05-02</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837367	HV20	NY-01117840	<i>Lendemer 10-02-07-01</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837368	HV21	NY-01117841	<i>Lendemer 10-02-07-02</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837369	HV03	NY-01117836	<i>Munch s.n.</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837370	HV04	NY-01117837	<i>Munch s.n.</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837371	HV06	NY-01117839	<i>Munch s.n.</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837372	HV07	NY-01117835	<i>Munch s.n.</i>	U.S.A. Pennsylvania
<i>P. hydrothyria</i>	JF837374	HV25	NY-01117830	<i>Huber s.n.</i>	U.S.A. Virginia

Lichens of Eastern North America Exsiccati, Fascicle IX, Nos. 401-445.

JAMES C. LENDEMER¹

ABSTRACT. – Data for the ninth fascicle, comprising the nos. 401 to 445, of *Lichens of Eastern North America Exsiccati* is presented. This fascicle of the exsiccat is distributed on exchange from The New York Botanical Garden to B, BG, CANB, CHR, CONC, FH, GZU, H, HMAS, KANU, LD, M, MIN, S, TNS, TU, UPS and hb. Kalb. The primary set resides at NY.

INTRODUCTION

In conjunction with the author's work on the lichen biota of eastern North America he began the distribution of this exsiccat (*Lichens of Eastern North America Exsiccati*) from the Academy of Natural Sciences of Philadelphia (PH). This, the ninth fascicle in the series is distributed from the New York Botanical Garden (NY) where the author is now employed. This fascicle comprises the nos. 401-445, and is distributed in 20 sets on exchange to the following herbaria: B, BG, CANB, CHR, FH, GZU, H, HMAS, KANU, LD, M, MIN, S, TNS, TU, UPS and hb. Kalb. The primary set resides at NY.

FASCICLE IX – NOS. 401-445

401. *Caloplaca yuchiorum* Lendemer & C.A. Morse
Det. J.C. Lendemer, 2010

ISOTYPE

UNITED STATES OF AMERICA. SOUTH CAROLINA. AIKEN COUNTY: Savannah River Bluffs Heritage Preserve, SW of Old Plantation Road, ca. 1 mi SW of I-20 and GA230 intersection. – elev. ca. 80 m. – Lat. 33° 31' 37"N, Long. 82° 00' 22"W – Mesic mixed hardwood bluff forest with felsic/mafic outcrops. – On rock of bluff.

James C. Lendemer #22026

13 March 2010

402. *Platythecium grammitis* (Fée) Staiger
Dup. Det. R. Lücking

HAITI. DEPT. DE L'OUEST: Ridge north of Foret des Pins (SHADA station), near border of Dominican Republic. – elev. 5800 ft. – Montane thicket. – On bark.

Henry A. Imshaug #22721
w/ Clifford M. Wetmore

14.July.1958

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403. *Calicium leucochlorum* Tuck.
Det. J.C. Lendemer, 2009

UNITED STATES OF AMERICA. FLORIDA. COLLIER COUNTY: Everglades City, grounds of the Rod & Gun Club. – Lat. 25° 51' 30"N, Long. 81° 23' 12"W – Planted trees along roadside. – On *Sabal*.

James C. Lendemer #15714

4.March.2009

404. *Everniastrum catawbiense* (Degel.) Hale ex Sipman
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. MAINE. WASHINGTON COUNTY: Town of Beals, Great Wass Island, Great Wass Island TNC Preserve, Loop Trail. – elev. 20-70 ft. – Lat. 44° 29' 01"N to 44° 28' 10"N, Long. 67° 35' 00"W to 67° 34' 22"W – Pine barrens over granite outcrops grading to maritime forest (*Picea*, *Abies*, *Betula*) and rocky exposed shoreline. – On dead *Picea*.

James C. Lendemer #22673

7.June.2010

405. *Scoliciosporum pruinosum* (P. James) Vězda
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. MAINE. WASHINGTON COUNTY: Town of Beals, Great Wass Island, Great Wass Island TNC Preserve, Loop Trail. – elev. 20-70 ft. – Lat. 44° 29' 01"N to 44° 28' 10"N, Long. 67° 35' 00"W to 67° 34' 22"W – Pine barrens over granite outcrops grading to maritime forest (*Picea*, *Abies*, *Betula*) and rocky exposed shoreline. – On dead *Betula*.

James C. Lendemer #22674

7.June.2010

406. *Loxospora cismonica* (Beltr.) Hafellner
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. MAINE. HANCOCK COUNTY: T10 SD, Maine Public Reserve Lands, 0-0.25 mi N of ME 82 directly across from Tunk Lake Access. – elev. 200 ft. – Lat. 44° 36' 38"N, Long. 68° 03' 24"W – Riparian hardwoods (*Acer*, *Betula*, *Fraxinus*) with *Thuja* and *Picea* in dryer areas. – On *Abies*.

James C. Lendemer #23038

10.June.2010

407. *Parmotrema austrosinense* (Zahlbr.) Hale
Det. B.P. Hodkinson, 2010

UNITED STATES OF AMERICA. NORTH CAROLINA. DURHAM COUNTY: City of Durham, Duke University West Campus, at the intersection of Lasalle St. and Circuit Dr. – Lat. 36° 00' 19"N, Long. 78° 56' 37"W – On bark of *Cercis canadensis*.

Brendan P. Hodkinson #11532

24 August 2010

408. *Cladonia fimbriata* (L.) Fr.
Det. R.C. Harris, 2010

CANADA. ONTARIO. BRUCE COUNTY: Bruce Peninsula National Park, Halfway Log Dump on Georgian Bay. – Lat. 45° 14' 01"N, Long. 81° 28' 41"W – elev. ~180 m. – *Thuja*-dominated forest over Silurian dolomite with numerous moss-covered boulders and escarpments. – On soil in roots of fallen tree.

Richard C. Harris **#56471**

24 September 2010

409. *Arthonia mesoleuca* Nyl.
Det. R.C. Harris, 2010

UNITED STATES OF AMERICA. FLORIDA. LIBERTY COUNTY: Apalachicola National Forest, Porter Lake Picnic Area, along Ochlockonee River. – On trunk of *Quercus*.

Richard C. Harris **#1659**

14 April 1967

410. *Dermatocarpon arenosaxi* Amtoft
Det. Anja Amtoft, 2008

ISOTYPE

UNITED STATES OF AMERICA. ARKANSAS. STONE COUNTY: 2.1 mi S of White River on St. Rd. 5. – T17N R11W Sect. 20 – Seepy sandstone glade. – On sandstone, forming subfruticose mounds in flowing water.

Richard C. Harris **#21644**

26 April 1988

411. *Megalaria isidiza* (Makhija & Nagarkar) Fryday & Lendemer
Det. J.C. Lendemer, 2010

CUBA. ORIENTE: seaside slope, Loma del Gato, Sierra Maestra. – Cultivated area. – On bark.

Henry A. Imshaug **#24929**

13. August. 1959

412. *Variolaria floridana* (Dibben) ined.
Det. R.C. Harris, 2010

UNITED STATES OF AMERICA. FLORIDA. MARION COUNTY: Ocala National Forest, Hughes Island. – Slightly moister oak woods surrounded by dry sand pine scrub. – On trunk of *Quercus*.

Richard C. Harris **#2023**

22 April 1967

413. *Phyllopsora kalbii* Brako
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. MISSOURI. MARIES COUNTY: Clifty Creek Natural Area, ~5.5 air mi E/NE of Dixon, ~0.8 miles NE of terminus of MO W. – 38.03° N, 91.98° W – [SW1/4 NE1/4 sec. 2 T38N R10W] – Wooded N-facing slope & low dolomite bluff along Clifty Creek; narrow floodplain terrace along creek with *Carpinus*, *Platanus*, *Acer*, *Quercus*; upland of chert residuum with sandstone outcrops and float, dominated by open *Quercus* and *Carya*. – On *Quercus*.

James C. Lendemer **#25770**
w/ Doug Ladd

4 October 2010

414. *Dermatocarpon arenosaxi* Amtoft
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. ARKANSAS. FAULKNER COUNTY: Cove Creek Natural Area, along W side of Cover Creek just above confluence w/ Cadron River, at E end of Conway Co. Rd. JD, ~6.2 miles N/NW of jct AR285 & AR25 in Wooster. – 35.29° N, 92.48° W – [NW1/4 sec. 34 T8N R14W] –E- & S-facing sandstone bluffs along river; uplands W of bluff late-successional stand dominated by *Juniperus virginiana* in former cleared area, with *Quercus*, *Ulmus*, *Liquidambar*, *Callicarpa*. – On rock in dry streambed.

James C. Lendemer #26255
w/ Doug Ladd & Caleb Morse

7 October 2010

415. *Naetrocymbe punctiformis* (Schränk) R.C. Harris
Det. R.C. Harris, 2010

UNITED STATES OF AMERICA. NEBRASKA. CEDAR COUNTY: Green Island Wildlife Management Area, ca. 1 mi S of Yankton. – 42° 51.70' N, 97° 24.26' W – elev. ca. 1200 ft. – Backwaters and island of the Missouri River; sandy riparian ecosystem with green ash, juniper, black locust, scattered cottonwoods, shrubs, brome-grass. – on green ash.

M.K. Advaita #8656

12 April 2010

416. *Physciella melanchra* (Hue) Essl.
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. SOUTH DAKOTA. CODDINGTON COUNTY: Pelican Lake State Recreation Area, ca. 3 mi S, 3 mi W of Watertown. – 44° 51.33' N, 97° 11.79' W – elev. ca. 430 m. – South shore of lake, mowed campgrounds with scattered trees and shelterbelts, plum thickets, some lakeside cottonwoods; minimal relief. – On stump of 20" dbh cottonwood at shoreline.

M.K. Advaita #8518

30 March 2010

417. *Pseudosagedia isidiata* (R.C. Harris) R.C. Harris
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. ARKANSAS. STONE COUNTY: Hell Creek Natural Area, ~3.5 miles N/NE of Mountain View. – 35.91° N, 92.08° W – [E1/2 sec. 30 T15N R10W] – Extensive limestone canyon & karstic bedrock system in steep N-trending valley, massive non-cherty limestone bluffs, flats, outcrops, ledges, boulders; dissected woodlands on cherty soils w/ *Fraxinus*, *Quercus*, *Juglans* in mesic lower areas & *Quercus*, *Carya*, *Amelanchier arborea*, *Vaccinium arboreum* above. – On *Quercus*.

James C. Lendemer #26506
w/ Doug Ladd

8 October 2010

418. *Leptogium juniperinum* Tuck.
Det. J.C. Lendemer, 2010

UNITED STATES OF AMERICA. PENNSYLVANIA. JEFFERSON COUNTY: Clear Creek State Forest, Callen Run Rd. 1.25 mi S of jct w/ PA 949. – 41° 19' 50" N, 78° 59' 12" W – elev. 1775 ft. – Rocky mixed hardwoods (*Acer*, *Quercus*) forest with mature trees near buried pipeline. – On humus along roadside.

James C. Lendemer #24758-A

8 September 2010

425. *Buellia catasema* (Tuck.) Tuck.
Det. R.C. Harris, 2011

UNITED STATES OF AMERICA. FLORIDA. MARION COUNTY: Ocala National Forest, Eton Creek and Florida Highway 314. – Moist woods along creek. – On trunk of *Sabal*.

Richard C. Harris #2408 29 April 1967

426. *Bacidia bagliettoana* (A. Massal. & De Not.) Jatta
Det. J.C. Lendemer, 2011

UNITED STATES OF AMERICA. NEBRASKA. VALLEY COUNTY: David Creek State Wildlife Management Area, ca 5 mi S of North Loup. - 41° 24.96' N, 98° 46.57' W. - elev. ca. 1960 ft. – Diversion canal with narrow band of cottonwoods and elms along waterway; adjacent agricultural land (row crops and pasture); gently rolling loess hills. – On soil of near-vertical N-facing road-cut.

M.K. Advaita #9357 6 May 2010

427. *Ramalina menziesii* Taylor
Det. Kerry Knudsen, 2010

UNITED STATES OF AMERICA. CALIFORNIA. SAN LUIS OBISPO COUNTY: Central Coast, San Simeon, San Simeon State Park, top of north slope above San Simeon Creek, Pico Creek Quad. - 35° 35' 24" N, 121° 06' 56" W. - elev. 180 ft. – Native Monterey Pine forest. – Abundant on *Pinus radiata* throughout forest.

Kerry Knudsen #12128 12 May 2010

428. *Loxosporopsis corallifera* Brodo et al.
Det. J.C. Lendemer, 2011

CANADA. BRITISH COLUMBIA. CAPITAL REGIONAL DISTRICT: Vancouver Island, Port Renfrew, 0.25 mi NW of terminus of Powderman Rd. – 48° 32' 34" N, 124° 25' 07" W – elev. 401 ft. – Conifer forest remnant on ridge w/ surrounding hardwoods. – On conifer.

James C. Lendemer #22422 27 May 2010
w/ Andrei Moroz

429. *Acarospora piedmontensis* K. Knudsen
Det. J.C. Lendemer, 2011

UNITED STATES OF AMERICA. GEORGIA. DeKALB COUNTY: Davidson-Arabia Mountain Nature Preserve, 3787 Klondike Road, W-facing slope of Arabia Mountain. – 33.66415° N, 84.12058° W – elev. 280 m. – On gneiss in full sun.

Sean Q. Beeching s.n. 28 March 2011

430. *Coenogonium luteum* (Dicks.) Kalb & Lücking
Det. J.C. Lendemer, 2011

UNITED STATES OF AMERICA. CONNECTICUT. WINDHAM COUNTY: Town of Westford, Yale Myers Forest, Boston Hollow, along Boston Hollow Road between Eastford Road and Barlow Road. - 41° 55' 57" N, 72° 09' 44" W – Mixed conifer-hardwood forest with extensive rock outcrops. – On maple (*Acer*).

William R. Buck #55554 19 September 2009

431. *Opegrapha longissima* Müll. Arg.
Det. J.C. Lendemer, 2011

UNITED STATES OF AMERICA. FLORIDA. COLLIER COUNTY: Fakahatchee Strand State Preserve, along Janes Memorial Scenic Drive, ca. 2 mi NNW of Ranger Station. – Lat. 25° 58' 58"N, Long. 81° 23' 22"W – *Taxodium*-hardwood swamp. – On dead trunk of *Sabal*.

James C. Lendemer #15675

4 March 2009

432. *Chaenotheca laevigata* Nád. v.
Det. R.C. Harris, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, Barnaby Head Trail between Raspberry Cove and Chitticks Beach. - 46°07'50"N 66°31'31"W – Seepy boggy mixed conifer (*Abies*, *Picea*) forest with mixed hardwoods (*Sorbus*, *Alnus*, *Betula*) and rock outcrops in forest and along shore. – On dead *Picea*.

William R. Buck #57619

29 April 2011

433. *Biatora pycnidiata* Printzen & Tønsberg
Det. R.C. Harris, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, Barnaby Head Trail between Raspberry Cove and Chitticks Beach. - 46°07'50"N 66°31'31"W – Seepy boggy mixed conifer (*Abies*, *Picea*) forest with mixed hardwoods (*Sorbus*, *Alnus*, *Betula*) and rock outcrops in forest and along shore. – On dead *Abies*.

William R. Buck #57603

29 April 2011

434. *Biatora pycnidiata* Printzen & Tønsberg
Det. R.C. Harris, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, Barnaby Head Trail between Raspberry Cove and Chitticks Beach. - 46°07'50"N 66°31'31"W – Seepy boggy mixed conifer (*Abies*, *Picea*) forest with mixed hardwoods (*Sorbus*, *Alnus*, *Betula*) and rock outcrops in forest and along shore. – On dead spruce.

Richard C. Harris #56582

29 April 2011

435. *Cladonia farinacea* (Vain.) A. Evans
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, N end of Park, along New River just S of NB780 crossing. - 45°10'32"N 66°32'36"W – Rock ledges and outcrops along river, below disturbed gravel roadside. – On humus over rock ledge.

James C. Lendemer #27921

1 May 2011

436. *Fuscidea pusilla* Tønsberg
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Pennfield Parish, W of Jake Lee Rd., W and S of small unnamed lake at head of unnamed tributary to Love Lake Brook. - 45°12'16"N 66°37'49"W – *Thuja* swamp along brook and rocky bluffs above with mixed conifer (*Picea*, *Abies*) and hardwoods (*Acer*, *Betula*) forest. – On *Betula papyrifera*.

James C. Lendemer #28030

1 May 2011

437. *Xylographa opegraphella* Nyl. ex Rothr.
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, Barnaby Head Trail between Raspberry Cove and Chitticks Beach. - 46°07'50"N 66°31'31"W – Seepy boggy mixed conifer (*Abies*, *Picea*) forest with mixed hardwoods (*Sorbus*, *Alnus*, *Betula*) and rock outcrops in forest and along shore. – On driftwood along shore.

James C. Lendemer #27781

29 April 2011

438. *Stereocaulon condensatum* Hoffm.
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, N end of Park, along New River just S of NB780 crossing. - 45°10'32"N 66°32'36"W – Rock ledges and outcrops along river, below disturbed gravel roadside. – On sandy soil of roadside.

James C. Lendemer #27925

1 May 2011

439. *Opegrapha zonata* Körb.
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, N end of Park, along New River just S of NB780 crossing. - 45°10'32"N 66°32'36"W – Rock ledges and outcrops along river, below disturbed gravel roadside. – On rock in cool overhang at edge of shore

James C. Lendemer #27924

1 May 2011

440. *Porpidia crustulata* (Ach.) Hertel & Knoph
Det. R.C. Harris, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Saint James Parish, Grand Falls Flowage on St. Croix River, just below dam at parking area at terminus of NB725 NW of Upper Little Ridge. - 45°17'N 67°29'W – Humid mixed conifer (*Abies*, *Picea*, *Thuja*) and hardwood (*Acer*, *Betula*, *Populus*, *Fraxinus*) forest with non-calcareous sandstone outcrops. – On pebbles.

Richard C. Harris #56666

30 April 2011

441. *Bacidia kekesiana* R.C. Harris
Det. R.C. Harris, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Saint Patrick Parish, Caughey-Taylor Nature Preserve, E of NB127, N and E sides of Sam Orr Pond. - 45°09'56"N 67°02'49"W – Rhyolite and basaltic bluffs/outcrops in mixed conifer (*Picea*, *Abies*, *Thuja*) and *Betula* forest with occasional other hardwoods. – On *Thuja*.

James C. Lendemer #28091-B

2 May 2011

442. *Acarospora molybdina* (Wahlenb.) Trevis.
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, Barnaby Head Trail between Raspberry Cove and Chitticks Beach. - 46°07'50"N 66°31'31"W – Seepy boggy mixed conifer (*Abies*, *Picea*) forest with mixed hardwoods (*Sorbus*, *Alnus*, *Betula*) and rock outcrops in forest and along shore. – On rock outcrop along shore.

James C. Lendemer #27772

29 April 2011

443. *Cliostomum griffithii* (Sm.) Coppins
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Lepreau Parish, New River Beach Provincial Park, Barnaby Head Trail between Raspberry Cove and Chitticks Beach. - 46°07'50"N 66°31'31"W – Seepy boggy mixed conifer (*Abies*, *Picea*) forest with mixed hardwoods (*Sorbus*, *Alnus*, *Betula*) and rock outcrops in forest and along shore. – On dead tree.

James C. Lendemer #27784

29 April 2011

444. *Icmadophila ericetorum* (L.) Zahlbr.
Det. J.C. Lendemer, 2011

CANADA. NEW BRUNSWICK. CHARLOTTE COUNTY: Pennfield Parish, W of Jake Lee Rd., W and S of small unnamed lake at head of unnamed tributary to Love Lake Brook. - 45°12'16"N 66°37'49"W – *Thuja* swamp along brook and rocky bluffs above with mixed conifer (*Picea*, *Abies*) and hardwoods (*Acer*, *Betula*) forest. – On rotting log.

James C. Lendemer #28033

1 May 2011

445. *Acarospora Americana* H. Magn.
Det. K. Knudsen, 2011

UNITED STATES OF AMERICA. CALIFORNIA. SAN BENITO COUNTY: Coast Range, New Idria, mercury mine tailings near the stamp mill, Site 1, San Benito Mountain Quad. – elev. 2549 ft. - 36°24'55.5"N 120°40'21"W – Chaparral. – On mercury mine tailing in full sun.

Kerry Knudsen #13608
w/ Alan Fryday & Nishi Rajakaruna

22 April 2011

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Opuscula Philolichenum, Index to New Taxa Proposed in Volume No. 9, 2011

NEW TAXA (INCL. MYCOBANK NOS.)

Acarospora piedmontensis sp. nov. [MB#561535].....	55
Acarospora sphaerosperma sp. nov. [MB#561536].....	57
Bactrospora carolinensis comb. nov. [MB#561537].....	59
Calopadia schomerae sp. nov. [MB#561206].....	39
Lecanora zeroensis sp. nov. [MB#561538].....	60
Melanophloea americana sp. nov. [MB#561539].....	61
Peltigera gowardii sp. nov. [MB#561541].....	103
Pleopsidium stenosporum comb. nov. [MB#561535].....	79
Punctelia eganii sp. nov. [MB#561203].....	35
Ramboldia blochiana sp. nov. [MB#519896].....	2
Silobia hassei comb. nov. [MB#561200].....	27
Syncesia mascarena sp. nov. [MB#519604].....	6